THE PROCEEDINGS

OF THE

THIRD

ALL-INDIA SANITARY CONFERENCE

HELD AT

LUCKNOW

January 19th to 27th, 1914

VOLUME I

DISCUSSIONS AND RESOLUTIONS

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PREFATORY NOTE.

In addition to this volume, there are four separate volumes containing the papers read at the Sanitary Conference.

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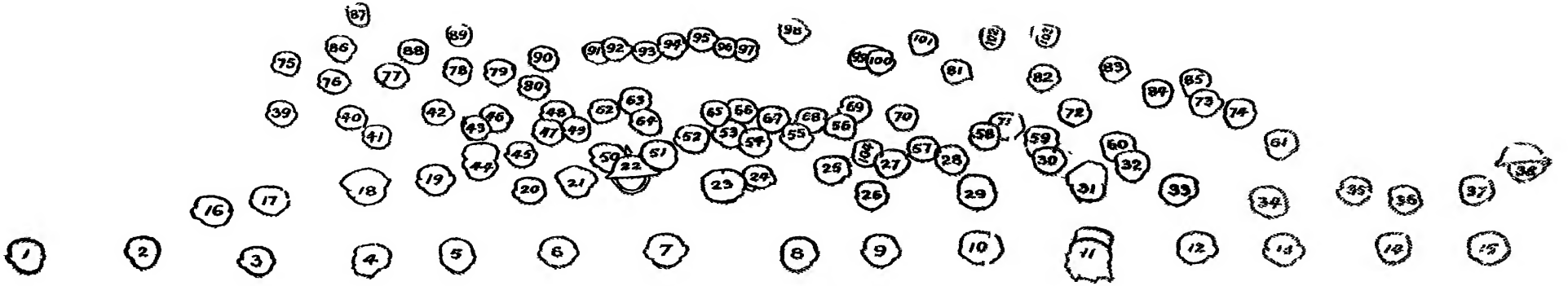
THIRD ALL-INDIA SANITARY CONFERENCE.

Lucknow, January, 1914.



(1) Captain F. Norman White, I.M.S. (2) Major W. Selby, I.M.S. (3) Lieut.-Col. S. A. Harriss, I.M.S. (4) Dr. Froilano de Mello. (5) The Hon. Mr. L. C. Porter. (6) The Hon. Sir Harcourt Butler. (7) His Honour Sir James Meston. (8) The Hon. Surgeon-General Sir Pardey Lukis, I.M.S. (9) The Hon. Major J. O. Robertson, I.M.S. (10) Sir Malcolm Morris. (11) The Hon. Rai Ganga Prasad Varma, Bahadur. (12) The Hon. Mr. C. H. Hutton. (13) The Hon. Mr. H. C. Ferard, I.C.S. (14) Kunwar Maharaj Singh. (15) Captain R. A. Needham, I.M.S. (16) Major W. A. Justice, I.M.S. (17) Dr. R. B. Khambata. (18) The Hon. Mr. M. Ramachandra Rao. (19) Dr. A. G. Newell. (20) Dr. Debi Dat Pandya. (21) Rao Sahib Ganesh Nagesh Sahasrabudhe. (22) Captain C. A. Watson Smyth. (23) The Hon. Rai Sri Ram Bahadur. (24) Dr. M. Srinivasa Rao. (25) Mr. E. G. Turner, I.C.S. (26) Rai Sahib Wazir Singh. (27) Captain W. S. Patton, I.M.S. (28) Dr. A. Lankester. (29) The Hon. Babu Dwarka Nath. (30) Captain H. G. Stiles-Webb, I.M.S. (31) Khan Bahadur Syed Mehdi Shah of Gojra. (32) Dr. J. B. Stephens. (33) Dr. S. Rozdon. (34) Dr. V. P. Korke. (35) Major H. C. Beadon, I.A. (36) Mr. H. T. S. Forest, I.C.S. (37) Mr. A. B. fforde, I.C.S. (38) Mr. C. H. West. (39) ———. (40) Mr. H. Lane Brown. (41) Dr. A. L. Shroff. (42) Mr. J. W. Madeley. (43) Dr. A. Sousa. (44) The Hon. Mr. Merwanjee Cowasjee. (45) Rai Kailash Chandra Bose, Bahadur. (46) Mr. P. R. Hewett. (47) Dr. E. F. Francis. (48) Mr. A. T. Daguid. (49) Major A. W. Cook-Young, I.M.S. (50) Dr. L. F. Hirst. (51) Dr. Mohammed Abdul Ghani. (52) Lt.-Col. H. J. Drake-Brockman, I.M.S. (53) Dr. K. McGahey. (54) Mr. P. L. Moore, I.C.S. (55) Major T. S. Ross, I.M.S. (56) Major T. G. N. Stokes, I.M.S. (57) Dr. K. [illegible]min. (58) Major C. S. Southon, I.M.S. (59) Mr. G. E. Fawcus. (60) Captain M. J. Quirke, I.M.S. (61) Mr. G. B. Williams. (62) Dr. Said-uz-zafar Khan. (63) Major C. H. Buck, I.A. (64) Major W. F. Harvey, I.M.S. (65) Major W. H. Kenrick, I.M.S. (66) Mr. P. R. Awati. (67) Captain J. Cunningham, I.M.S. (68) Captain A. E. Grisewood, I.M.S. (69) Captain J. C. G. Kinhardt, I.M.S. (70) Major W. G. Liston, I.M.S. (71) Dr. C. A. Bentley. (72) Major E. D. W. Greig, I.M.S. (73) Captain E. P. Mackie, I.M.S. (74) Lt.-Colonel E. O. Hare, I.M.S. (75) Mr. G. P. Robertson. (76) Mr. E. Gabbett. (77) Mr. W. Hutton. (78) Major L. W. S. Oldham, R.E. (79) Mr. C. W. E. Montgomerie. (80) Babu Bepin Behari Brahmachari. (81) Mr. G. W. Disney. (82) Major E. Bisset, I.M.S. (83) Captain C. A. Gill, I.M.S. (84) Mr. J. D. Fraser, I.C.S. (85) The Hon. Mr. James Donald, I.C.S. (86) Major J. D. Graham, I.M.S. (87) Captain A. Cameron, I.M.S. (88) The Hon. Mr. J. P. Orr, I.C.S. (89) Mr. H. A. Gubbay. (90) Major S. R. Christophers, I.M.S. (91) Captain H. M. Brown, I.M.S. (92) Dr. W. J. Wanless. (93) Captain E. C. Hodgson, I.M.S. (94) Mr. T. Salkield. (95) Lt.-Colonel C. Donovan, I.M.S. (96) Captain H. W. Acton, I.M.S. (97) Captain T. C. McCombie-Young, I.M.S. (98) Major F. H. G. Hutchinson, I.M.S. (99) Lt.-Colonel C. E. Williams, I.M.S. (100) Lt.-Colonel S. Browning-Smith, I.M.S. (101) Dr. J. A. Turner. (102) Major E. L. Perry, I.M.S. (103) Mr. H. N. Bolton, I.C.S. (104) Rai Upendranath Brahmachari Bahadur.

ALL-INDIA SANITARY CONFERENCE

LUCKNOW

JANUARY 1914.

PRESIDENT.

The Honourable Sir Harcourt Butler, K.C.S.I., C.I.E., I.C.S., Member of the Governor-General's Council, in charge of the Department of Education.

DELEGATES

INDIA.

1. The Honourable Mr. L. C. Porter, C.I.E., I.C.S., Secretary to the Government of India, Department of Education.
2. The Honourable Surgeon-General Sir Charles Pardey Lukis, K.C.S.I., K.H.S., M.D., F.R.C.S., I.M.S., Director-General, Indian Medical Service.
3. The Honourable Major J. C. Robertson, C.I.E., M.A., B.Sc., M.B., D.P.H., I.M.S., Sanitary Commissioner with the Government of India.
4. Kunwar Maharaj Singh, M.A., Barrister-at-Law, Assistant Secretary to the Government of India, Department of Education.
5. Captain F. Norman White, M.D., I.M.S., Assistant Director-General, Indian Medical Service (Sanitary).
6. Captain R. A. Needham, M.B., B.Sc., D.P.H., I.M.S., Health Officer, Simla.
7. Major W. F. Harvey, M.A., M.B., D.P.H., I.M.S., Director, Central Research Institute, Kasauli.
8. Major S. R. Christophers, M.B., I.M.S., Assistant Director, Central Research Institute, Kasauli.
9. Major E. D. W. Greig, M.D., D.Sc., I.M.S., Officer on special duty under the Indian Research Fund Association.
10. Major R. McCarrison, M.D., I.M.S., Officer on special duty under the Indian Research Fund Association.
11. Captain F. P. Mackie, M.B., F.R.C.S., I.M.S., Officer on special duty under the Indian Research Fund Association.
12. Dr. V. T. Korke, Officer on special duty under the Indian Research Fund Association.
13. Captain J. Cunningham, M.D., I.M.S., Officer on special duty under the Indian Research Fund Association.
14. Major A. C. MacGilchrist, M.D., D.Sc., I.M.S., Officer on special duty under the Indian Research Fund Association.
15. Captain J. C. G. Kunhardt, M.B., I.M.S., Member, Plague Research Commission.
16. Dr. W. J. Wanless, M.D., President, Medical Missionary Association of India, Miraj, Kolhapur.
17. Dr. A. Lankester, M.D., Honorary Secretary, Medical Missionary Association of India, Church Missionary Society, Peshawar.
18. Sir Edward C. Buck, K.C.S.I., LL.D.
19. Mr. C. A. B. Olliver, Lucknow.

20. Mr. A. Howard, M.A. A.R.C.S., F.L.S., Imperial Economic Botanist.

MADRAS.

21. The Honourable Surgeon-General W. B. Bannerman, C.S.I., M.D., D.Sc., I.M.S, Surgeon-General with the Government of Madras.

22. Major W. A. Justice, M.B., D.P.H., I.M.S., Sanitary Commissioner, Madras.

23. Mr. W. Hutton, A.M.I.C.E., Sanitary Engineer, Madras.

24. Lieutenant-Colonel C. Donovan, B.A., M.D., B.Ch., B.A.O., I.M.S., Surgeon, Fourth District, Madras.

25. Captain W. S. Patton, M.B., I.M.S., Assistant Director, King Institute, Madras.

26. Captain M. J. Quirke, M.B., D.P.H., I.M.S., Deputy Sanitary Commissioner, Madras.

27. Mr. P. L. Moore, C.I.E., I.C.S., President, Corporation of Madras.

28. Mr. J. W. Madeley, M.A., M.I.C.E., Special Engineer, Corporation of Madras.

29. The Honourable Rao Bahadur M. Ramachandra Rao Pantulu Garu, Member, Madras Legislative Council and Chairman, Municipal Council, Ellore.

30. Major T. S. Ross, D.P.H., I.M.S., Special Malaria Officer, Madras.

31. Captain J. H. Horne, M.B., I.M.S., Special Malaria Officer, Madras.

32. Captain E. C. Hodgson, M.B., D.P.H., I.M.S., Special Malaria Officer, Madras Corporation.

BOMBAY.

33. Major F. H. G. Hutchinson, M.B., C.M., D.P.H., I.M.S., Sanitary Commissioner, Bombay.

34. Mr. H. O. B. Shoubridge, M.I.C.E., Sanitary Engineer to the Government of Bombay.

35. Major W. G. Liston, C.I.E., M.D., D.P.H., I.M.S., Director, Bombay Bacteriological Laboratory.

36. Dr. H. H. Mann, D.Sc., Principal of the Agricultural College and Agricultural Chemist, Poona.

37. Mr. O. H. T. Dudley, M.A., Inspector of European Schools, Bombay.

38. The Honourable Mr. J. P. Orr, C.S.I., I.C.S., Chairman, City of Bombay Improvement Trust.

39. Mr. E. G. Turner, I.C.S., Special Officer, Salsette Building Sites.

40. Dr. J. A. Turner, M.D., D.P.H., Executive Health Officer, Bombay Municipality.

41. The Honourable Mr. Kashinath Ramchandra Godbole, Member, Bombay Legislative Council.

42. Dr. A. L. Shroff, Health Officer, Karachi Municipality.

43. Dr. Kashibhai Vaghjibhai Amin, L.R.C.P. & S., D.P.H., Health Officer, Ahmedabad Municipality.

44. Mr. C. N. Mandy, C.E., Executive Engineer in charge, Poona Drainage and Water-supply Works.

45. Mr. R. J. Kent, A.M.I.C.E., Engineer, City of Bombay Improvement Trust.

46. Mr. W. R. Philpot-Brookes, A.M.I.C.E., A.K.C., Engineer, Salsette Building Sites.

47. Major J. L. Marjoribanks, M.D., D.P.H., I.M.S., Deputy Sanitary Commissioner, Western Registration District, Bombay.

48. Mr. G. H. Thiselton Dyer, M.A., A.M.I.C.E., Mechanical Engineer to the Government of Bombay.

49. Major T. H. Gloster, M.B., D.P.H., I.M.S., Assistant Director, Bombay Bacteriological Laboratory.

BENGAL.

50. The Honourable Mr. James Donald, I.C.S., Secretary to the Government of Bengal.

51. Lieutenant-Colonel L. Rogers, C.I.E., M.D., F.R.C.P., F.R.C.S., I.M.S., Professor of Pathology, Medical College, Calcutta, and Bacteriologist to the Government of Bengal.

52. Major W. W. Clemesha, M.D., D.P.H., I.M.S., Sanitary Commissioner, Bengal.

53. Mr. G. B. Williams, M.I.C.E., M.I.M.E., Sanitary Engineer, Bengal.

54. Dr. C. A. Bentley, M.B., D.P.H., Special Officer for Malaria Research, Bengal.

55. Dr. R. B. Khambata, Deputy Sanitary Commissioner, Bengal.

56. Rai Upendra Nath Brahmachari Bahadur, M.A., M.D., Teacher of Medicine, Campbell Medical School, Calcutta.

57. Babu Bepin Behari Brahmachari, L.M.S., Health Officer, Cossipur-Chitpur Municipality.

58. Mr. G. P. Robertson, Municipal Engineer, Darjeeling.

59. Rai Kailash Chandra Bose Bahadur, C.I.E., L.M.S., Municipal Commissioner, Calcutta.

60. Mr. J. Ball-Hill, A.M.I.C.E., Executive Engineer, Suburban Drainage Works, Calcutta Corporation.

UNITED PROVINCES.

61. The Honourable Mr. C. H. Hutton, Chief Engineer and Secretary to the Government, United Provinces, Irrigation Department.

62. Major S. A. Harriss, M.B., C.M., D.T.M., D.P.H., I.M.S., Sanitary Commissioner, United Provinces.

63. Major J. D. Graham, M.B., D.T.M., I.M.S., Special Malaria Officer, United Provinces.

64. Mr. A. W. E. Standley, Superintending Engineer, 2nd Circle, Irrigation Works, United Provinces.

65. Mr. C. H. West, Sanitary Engineer, United Provinces.

66. Captain A. Cameron, M.B., I.M.S., Chief Plague Officer, United Provinces.

67. Major E. Bisset, M.B., D.P.H., I.M.S., Deputy Sanitary Commissioner, United Provinces.

68. Dr. Debi Dat Pandya, D.P.H., Deputy Sanitary Commissioner, United Provinces.

69. Dr. Kishan Lal Nehru, M.B., B.Sc., Deputy Sanitary Commissioner, United Provinces.

70. Mr. A. B. fforde, I.C.S., Deputy Commissioner, Lucknow.

71. Mr. G. G. Sim, I.C.S., Chairman, Municipal Board, Cawnpore.

72. The Honourable Rai Sri Ram Bahadur, C.I.E., M.A., B.L., Member of the Imperial Legislative Council.

73. The Honourable Rai Ganga Prasad Varma Bahadur, of Lucknow, Member, United Provinces Legislative Council.

74. Mr. P. R. Hewlett, A.M.I.C.E., Consulting Engineer, Lucknow Municipality.

75. Major W. Selby, D.S.O., V.H.S., F.R.C.S., I.M.S., Principal, King George's Medical College, Lucknow.

76. Dr. A. Sousa, F.R.C.S., D.P.H., F.S.Sc., Health Officer, Lucknow Municipality.

77. Mr. Said-uz-zafar Khan, M.B., D.T.M., Professor of Anatomy, King George's Medical College, Lucknow.

78. Hakim Abdul Hamid of Lucknow.

79. Mr. H. Lane Brown, M.I.C.E., of Messrs. Lane Brown & Hewlett, Consulting Engineers, Lucknow and Nagpur.

Punjab.

80. Major C. H. Buck, I.A., Deputy Commissioner, Karnal.
81. Lieutenant-Colonel S. Browning Smith, D.P.H., I.M.S., Officiating Sanitary Commissioner, Punjab.
82. Major E. L. Perry, D.P.H., I.M.S., Deputy Sanitary Commissioner, Punjab.
83. Major C. E. Southon, M.B., I.M.S., Chief Plague Medical Officer, Punjab.
84. Captain C. A. Gill, D.P.H., I.M.S., Chief Malaria Medical Officer, Punjab.
85. Dr. A. G. Newell, M.D., D.P.H., Health Officer, Lahore.
86. Dr. S. Rozdon, D.P.H., Health Officer, Amritsar.
87. Mr. A. S. Montgomery, Sanitary Engineer, Punjab.
88. Diwan Amar Nath Nanda, Assistant Sanitary Engineer Punjab.
89. Khan Bahadur Syed Mehdi Shah of Gojra, District Lyallpore.

Burma.

90. Lieutenant-Colonel C. E. Williams, M.A., M.D., B.C., D.T.M. D.P.H., I.M.S., Sanitary Commissioner, Burma.
91. Mr. E. Gabbett, V.D., M.I.C.E., M.R.S.I., Sanitary Engineer, Burma.
92. Mr. J. D. Fraser, I.C.S., Deputy Commissioner, Amherst.
93. The Honourable Mr. Merwanjee Cowasjee, Member, Burma Legislative Council.
94. Dr. J. B. Stephens, Municipal Health Officer, Rangoon.

Bihar and Orissa.

95. Mr. H. T. S. Forest, I.C.S., Magistrate and Collector.
96. Lieutenant-Colonel E. C. Hare, D.P.H., I.M.S., Sanitary Commissioner, Bihar and Orissa.
97. Captain H. M. Brown, M.B., D.P.H., I.M.S., Offg. Deputy Sanitary Commissioner, Bihar and Orissa.
98. Mr. G. W. Disney, V.D., M.I.C.E., F.R.S.I., Sanitary Engineer, Bihar and Orissa.
99. Mr. G. E. Fawcus, M.A., Inspector of Schools, Bhagalpur Division.
100. Mr. H. A. Gubbay, A.M.I.C.E., Executive Engineer, Public Works Department, Bihar and Orissa.
101. The Honourable Babu Dwarka Nath, B.A., LL.B., Member, Bihar and Orissa Legislative Council.

Central Provinces.

102. Major T. G. N. Stokes, B.A., M.B., B.Ch., B.A.O., L.M., D.T.M., I.M.S., Sanitary Commissioner, Central Provinces.
103. Major L. W. S. Oldham, R.E., A.M.I.C.E., Sanitary Engineer, Central Provinces.
104. Major W. H. Kenrick, L.R.C.P., M.R.C.S., D.T.M., I.M.S., Special Malaria Officer, Central Provinces.
105. Mr. C. W. E. Montgomerie, I.C.S., Deputy Commissioner, Saugor.
106. Rao Sahib Ganesh Nagesh Sahasrabudhe, Vice-Chairman, Ellichpur Municipal Committee.
107. Captain A. E. Grisewood, M.B., I.M.S., Chief Plague Medical Officer, Central Provinces.

N.-W. F. Province.

108. Mr. H. N. Bolton, I.C.S., Deputy Commissioner, Peshawar.
109. Captain H. G. Stiles Webb, D.T.M. & H., D.P.H., I.M.S., Deputy Sanitary Commissioner, North-West Frontier Province.

Assam.

110. Lieutenant-Colonel D. Herbert, Deputy Commissioner, Lakhimpur.
111. Captain T. C. McCombie-Young, M.B., D.P.H., I.M.S., Deputy Sanitary Commissioner, Assam.
112. Mr. A. T. Daguid, Officer on special duty in connection with Sanitary Board Schemes, Assam.
113. Dr. E. E. Francis, Chief Medical Officer, Assam-Bengal Railway.
114. Babu Satish Chandra Deb, Vice-Chairman, Karimganj Municipality.

Delhi.

115. Major H. C. Beadon, I.A., Deputy Commissioner, and President, Delhi Municipal Committee.
116. Major A. W. Cook Young, M.B., D.P.H., D.T.M. & H., I.M.S., Health Officer, Delhi.
117. Mr. T. Salkield, M.I.C.E., M.R.S.I., Municipal Engineer, Delhi.
118. Mr. H. E. Parker, Sanitary Engineer, Delhi.
119. Rai Sahib Wazir Singh, Municipal Commissioner, Delhi.

Ceylon.

120. Dr. K. McGahey, Senior Sanitary Officer, Ceylon.
121. Mr. N. M. Ingram, Works Engineer, Colombo Municipality
122. Dr. L. F. Hirst, Bacteriologist, Colombo Municipality.
123. Mr. C. L. Cox, City Sanitation Engineer, Colombo Municipality (absent).

Hyderabad.

124. Lieut.-Colonel H. E. Drake-Brockman, F.R.C.S.E., I.M.S., Director, Medical Department and Sanitary Commissioner to His Highness the Nizam's Government.
125. Mr. P. A. Bhaunani, B.A., C.E., Sanitary Engineer, His Highness the Nizam's Government.
126. Dr. Mohammad Abdul Ghani, M.B., C.M., D.P.H., M.R.C.S., Deputy Commissioner, H. H. The Nizam's Municipal Department.

Mysore.

127. Mr. K. Krishna Iyengar, B.A., L.C.E., Deputy Chief Engineer, Mysore Durbar (absent).
128. Dr. M. Srinivasa Rao, M.A., M.D., D.P.H., Director, Public Health Institute and Deputy Sanitary Commissioner, Mysore Durbar.

Portuguese India.

129. Lieutenant Dr. Froilano de Mello, Doctor of the "Board of Health" and Surgeon of the School of Goa and that of Porto (Portugal).

Visitors.

Sir Malcolm Morris, K.C.V.O., The Honourable Mr. R. Burn, I.C.S., Surgeon-General H. G. Hathaway, C.B., R.A.M.C., The Honourable Colonel C. C. Manifold, I.M.S., The Honourable Lieut.-Col. C. Mactaggart, C.I.E., I.M.S., The Honourable Mr. S. P. O'Donnell, I.C.S., the Honourable Mr. A. W. Pim, I.C.S., and The Honourable Mr. H. C. Ferard, C.I.E., I.C.S.

AGENDA.

1st Day—Monday, 19th January.

1st SESSION : 10—11-30 A.M.

FULL CONFERENCE.

(*a*) PRESIDENT'S OPENING ADDRESS.

(*b*) *The Italian System of reclamation of land by silt deposit with reference to the mitigation of Malaria.*

(1) "Report on the control and utilisation of rivers and drainage for the fertilisation of land and mitigation of Malaria," by Sir Edward Buck, K.C.S.I., LL.D.

(2) "Report on the utilisation of silt in Italy," with a supplementary note, by the Hon'ble Mr. C. H. Hutton.

(3) "Report on the Colmate di Monte of Italy," by Mr. F. Clayton, A.M.I.C.E.

(4) "A short note on the silting up of the Bistupur Bhil at Berhampur," by Major W. W. Clemesha, M.D., D.P.H., I.M.S.

2nd SESSION : 12—1-30 P.M.

SECTION A.

(*a*) *Rural Sanitation.*

(1) "Drainage and Sanitation in rural areas in the Madras Presidency," by the Hon'ble Rao Bahadur M. Ramachandra Rao, Pantulu Garu.

(2) "Rural Sanitation in the United Provinces of Agra and Oudh," by the Hon'ble Rai Sri Ram Bahadur, C.I.E., M.A.

(3) "Note on village sanitation," by the Hon'ble Mr. K. R. Godbole.

(*b*) *The Medical Inspection of Schools and the teaching of hygiene.*

(1) "Medical Inspection of Schools and School hygiene," by Rao Sahib G. N. Sahasrabudhe.

(2) "The unhygienic and insanitary condition of boys' and girls' schools in cities," by Rai-Bahadur Gopal Das Bhandari.

(3) "Education of teachers and children in hygiene," by Captain H. G. Stiles Webb, I.M.S.

SECTION B.

(*a*) *Conservancy.*

(1) "The prevalence of flies in Delhi and their reduction," by Major A. W. Cook Young, D.P.H., I.M.S.

(2) "Pail latrines and a plea for the sweeper," by Mr. G. P. Robertson.

(3) "Note on the Nasik system of pitting night-soil to ripen it for sale to cultivators," by Major J. L. Marjoribanks, M.D., D.P.H., I.M.S.

(4) "Note on the pitting of night-soil and manure in private compounds," by Major J. L. Marjoribanks, M.D., D.P.H., I.M.S.

(5) "A short note on incineration in India," by Captain H. G. Stiles Webb, I.M.S.

2nd Day—Tuesday, 20th January.

1st SESSION: 10—11-30 A.M.

SECTION A.

(*a*) *Infantile Mortality.*

(1) "Proposals for the formation of a Women's Domestic Sanitary Service for India," by Dr. A. M. Benson.

(2) "Nurse district visitors in Madras City," by Mr. P. L. Moore, C.I.E., I.C.S.

(3) "Infantile Mortality," by Dr. S. Rozdon, D.P.H.

(4) "High temperature as a cause of Infantile Mortality," by Major W. H. Kenrick, I.M.S.

(*b*) *Notification of diseases.*

(1) "What are the diseases whose notification should be rendered compulsory in Portuguese India," by Dr. Froilano de Mello.

(2) "Note on the notification of diseases," by Lieutenant-Colonel H. E. Drake-Brockman, I.M.S.

(3) "Notification as a means of prevention of the spread of infectious diseases," by Dr. Rai Kailash Chandra Bose Bahadur, C.I.E.

(*c*) *Tuberculosis.*

(1) "Tuberculosis in India. Some suggestions on its spread and prevention," by Dr. W. J. Wanless, M.D.

(2) "The organisation of anti-tuberculosis measures in India," by Majors A. W. R. Cochrane, M.B., F.R.C.S., I.M.S., and C. A. Sprawson, M.D., M.R.C.P., I.M.S.

(3) "Experience in treatment of Pulmonary tuberculosis in Indians by tuberculin," by Majors A. W. R. Cochrane, M.B., F.R.C.S., I.M.S.; and C. A. Sprawson, M.D., M.R.C.P., I.M.S.

(4) "A preliminary enquiry into the prevalence of tuberculosis amongst Bombay cattle," by Major T. H. Gloster, M.B., D.P.H., I.M.S.

SECTION B.

(*a*) *Water-Supply and Drainage bye-laws.*

(1) "Notes on assessment of water rates," by Major L. W. S. Oldham, R.E.

(2) "Notes on water-works and drainage bye-laws," by Mr. J. W. Madeley, M.A., M.I.C.E.

(*b*) *The Improvement of water-supply in municipalities and villages.*

(1) "Water-supply for small communities and municipalities," by Mr. G. W. Disney, M.I.C.E,

(2) "A new module," by Mr. C. F. Wilkins.

(*c*) *Tube Wells.*

(1) "Water-supply for the city and civil station of Sialkote," by Dewan Amar Nath Nanda, B.A.

2ND SESSION : 12—1-30 P.M.

SECTION A.

(*a*) *Milk Standards.*

(1) "Milk and milk products," by Dr. M. Srinivasa Rao, M.A., M.D., D.P.H.

(2) "Observations on the bacteriological and chemical examination of the milk supply of Bombay," by Dr. L. L. Joshi, M.D., B.Sc., D.T.M., with an introduction by Dr. J. A. Turner, M.D., D.P.H.

(3) "The composition of milk of the United Provinces," by Mr. P. S. McMahan.

(*b*) *Milk Trade.*

(1) "The supply of milk to Indian cities," by Dr. H. H. Mann, D.Sc.

(2) "Milk supply," by the Hon'ble Mr. Merwanjee Cowasjee.

(3) "Milk trade," by Dr. K. V. Amin, D.P.H.

(4) "A short note on milk supply," by Major T. G. N. Stokes, M.B., I.M.S.

(5) "Short note on milk supplies," by Captain H. G. Stiles Webb, I.M.S.

SECTION B.

(*a*) *Municipal Drainage.*

(1) "The exclusion of storm water and silt from sewerage systems," by Mr. J. W. Madeley, M.A., M.I.C.E.

(2) "A short note on sewers," by Mr. J. Ball Hill, A.M.I.C.E.

(3) "The disposal of sewage sludge," by Mr. D. Aikman, C.I.E.

(4) "Note on the maintenance of a sewerage system for an Indian city," by Mr. H. Bailey.

(*b*) *Width of Cart Tyres.*

(1) "Note on cart wheels and tyres" by Mr. T. Salkield, M.I.C.E.

EVENING POPULAR LECTURES.

3RD SESSION : 9-30—10-30 P.M.

(*a*) "Goitre," by Major R. McCarrison, M.D., I.M.S.

(*b*) "Malaria," by Major S. R. Christophers, M.B., I.M.S.

3rd Day—Wednesday, 21st January.

Inspection of Lucknow Town Improvement and Sanitation.

10—11-30 A.M.

FULL CONFERENCE.

(*a*) OPENING ADDRESS IN THE RESEARCH SECTION BY THE DIRECTOR-GENERAL, INDIAN MEDICAL SERVICE.

SECTION A.

(*b*) *Malaria.*

(1) "Contribution to the study of malaria in Goa," by Dr. Froilano de Mello.

(2) "The spleen rate in London school children," by Sir Ronald Ross, K.C.B., F.R.S., and Majors S. R. Christophers, and E. L. Perry, I.M.S.

(3) " Note on the parasite rate in the measurement of malaria," by Captain C. A. Gill, D.H.P., D.T.M. & H., I.M.S.
(4) " Report on certain features of Malaria in the Island of Salsette," by Major J. L. Marjoribanks, M.D., D.P.H., I.M.S.
(5) " Malaria and rice cultivation," by Major W. H. Kenrick, I.M.S.

2nd SESSION : 12—1-30 P.M.

SECTION A.

(*a*) *Malaria—(contd.)*

(1) " Malaria in Wynaad," by Captain J. H. Horne, M.B., I.M.S.
(2) " A short note on the use of larvicidal fish in combating malaria fever," by Dr. W. R. Macdonald.
(3) " A suggestion regarding anti-malaria sanitation specially adapted for Bengal," by Dr. C. A. Bentley, M.B., D.P.H.

(*b*) *Cholera.*

(1) " On the vitality of the cholera vibrio outside the human body," by Major E. D. W. Greig, M.D., D.SC., I.M.S.
(2) " A short note on cholera as an endemic in Cossipur-Chitpur, Bengal," by Dr. B. B. Brahmachari.

(*c*) *Relapsing fever.*

(1) " Relapsing fever in the Meerut Division," by Major E. Bisset, M.B., D.P.H., I.M.S.

(*d*) *Guinea-worm Disease.*

(1) " Guinea-worm disease in an Indian village," by Major W. Glen Liston, C.I.E., M.D., D.P.H., I.M.S., and Dr. D. A. Turkhud, M.B.
(2) " The distribution of guinea-worm in India," by Dr. D. A. Turkhud, M.B.

SECTION B.

Lantern Exhibition of Type Designs for—

(1) Markets.
(2) Slaughter-houses.
(3) Grain godowns.
(4) Cow sheds.
(5) Model dwellings for the poorer classes.
(6) Latrines and night-soil depôts.

(1) " Description of type designs relating to water carriage public latrines, Colombo," by Mr. C. L. Cox.
(2) " Note on night-soil depôts," by Mr. J. W. Madeley, M.A., M.I.C.E.
(3) " Note on flush-out latrines used in the City of Madras," by Mr. J. W. Madeley, M.A., M.I.C.E.

(7) Sewer connections.
(8) House connections and meters for water-supply.
(9) Well Heads.

(1) " Well heads and their protection against pollution," by Mr. H. A. Gubbay, A.M.I.C.E.

4th Day—Thursday, 22nd January.

Visit of inspection to Hardwar.

(1) Notes on Hardwar.

5th Day—Friday, 23rd January.

1ST SESSION: 10—11-30 A.M.

SECTION A.

(*a*) *Town-planning and improvement.*

(1) "How to check the growth of insanitary conditions in Bombay City," by the Hon'ble Mr. J. P. Orr, C.S.I., I.C.S.

(2) "Town improvement schemes and building bye-laws in the Madras Presidency," by the Hon'ble Rao Bahadur M. Ramachandra Rao, Pantulu Garu.

(3) "Sanitary improvement in urban areas" by Lala Jai Lal, B.A.

(4) "Extension of Bangalore City," by Mr. K. Iyengar, B.A.

SECTION B.

(*a*) *Mosquitoes.*

(1) "Synoptic arrangement of Indian anophelines with reference to teaching requirements," by Major S. R. Christophers, M.B., I.M.S.

(2) "Note on experiments to determine the reaction of mosquitoes to artificial light," by Dr. C. A. Bentley, M.B., D.P.H.

(*b*) *Kala-Azar.*

(1) "Kala-Azar in Assam," by Captain F. P. Mackie, M.B., F.R.C.S., I.M.S.

(2) "The bearing of Assam tea garden experience on the problem of the etiology of kala-azar," by Lieut.-Colonel L. Rogers, C.I.E., M.D., F.R.C.P., F.R.C.S., I.M.S.

(3) "Report on the progress of the kala-azar investigation during the season 1912-13," by Captain T. C. McCombie Young, M.B., D.P.H., I.M.S.

2ND SESSION: 12—1-30 P.M.

SECTION A.

Town-planning and improvement—contd.

(*a*) *Bacteriology of water.*

(1) "The bacteriology of the Colombo town and well water," by Dr. F. L. Hirst, M.D., D.P.H.

(*b*) *Filtration of water.*

(1) "Experiments in the filtration of water through slow sand and mechanical filters at the King Institute, Guindy, Madras," by Mr. W. Hutton, A.M.I.C.E.

6th Day—Saturday, 24th January.

1ST SESSION: 9—11 A.M.

SECTION A.

Inspection of Lucknow Sanitation and Town Improvement.

(1) "Note on the working of the Co-operative Dairy Society at Lucknow" by Major S. A. Harriss, I.M.S.

(2) "Note on the institution and management of co-operative dairies in the United Provinces, with special reference to the co-operative dairies in existence at Benares and Lucknow," by Mr. R. W. D. Willoughby, I.C.S.
(3) "Note on Lucknow," by the Hon'ble Rai Ganga Prasad Varma Bahadur.
(4) "A short descriptive note on Lucknow City sanitation," by Mr. P. R. Hewlett, A.M.I.C.E.
(5) "Lucknow water-works," by Mr. H. I. Carter, A.M.I.M.E.
(6) "A new filter-bed flow controller."

10—11-30 A.M.

SECTION B.

Plague.

(1) "Further investigations into the persistence of plague infection in the villages of Poona district during the off-season," by Captain J. C. G. Kunhardt, I.M.S.
(2) "Plague prophylactic measures during the off-season," by Captain J. C. G. Kunhardt, I.M.S.
(3) "Rat destruction and plague," by Lieut.-Colonel S. Browning-Smith, I.M.S.
(4) "The use and advantages of hydrocyanic acid gas as a disinfectant for plague-infected houses and ships," by Major W. Glen Liston, C.I.E., M.D., D.P.H., I.M.S.; Captains W. D. H. Stevenson, M.B., I.M.S.; and J. Taylor, M.D., D.P.H., I.M.S.

2nd SESSION : 12—1-30 P.M.

SECTION A.

Vital Statistics.

(1) "Note on some points of interest regarding vital statistics," by Dr. C. A. Bentley, M.D., D.P.H.
(2) "Note on some simple methods of testing the registration of vital occurrences in India," by Dr. C. A. Bentley, M.D., D.P.H.
(3) "Registration of vital statistics," by Captain T. G. McCombie Young, M.B., D.P.H., I.M.S.
(4) "Note on the registration of vital statistics in Sind," by Major W. Murphy, M.B., D.P.H., I.M.S.

SECTION B.

(*a*) *The use of cast iron, steel and ferro-concrete pipes for water-supply and drainage systems.*

(1) "Note on a reinforced concrete pipe for Ahmednagar water-supply," by Mr. T. S. Pipe, B.SC., A.M.I.C.E.

(*b*) *Statistics of consumption of water in water-works.*

(1) "Prevention of waste in water supplies," by Mr. C. H. West.

(*c*) *Statistics of pumping per pump horse-power per hour.*

(1) "Notes on the comparative cost of pumping at various water-works in the Central Provinces," by Major L. W. S Oldham, R.E.

7th Day—Sunday, 25th January.

Visit of inspection to Benares.

(1) Benares—I—Drainage. II—Minor Improvements. III—Water-works, by Mr. C. A. C. Streatfeild, I.C.S.

8th Day—Monday, 26th January.

Visit to Magh Mela at Allahabad.

9th Day—Tuesday, 27th January.

FULL CONFERENCE.

RESOLUTIONS.

Address by

H. H. SIR JAMES MESTON, K.C.S.I., LL.D.,

Lieut.-Governor of the United Provinces of Agra and Oudh.

FIRST DAY—MONDAY, 19TH JANUARY.

The Third All-India Sanitary Conference opened in the Convocation Hall of King George's Medical College at Lucknow at 10 A.M. on the 19th January, 1914. The Hon'ble Sir Spencer Harcourt Butler, K.C.S.I., C.I.E., I.C.S., Member of the Governor-General's Council in the Department of Education, presided and addressed the delegates as follows :—

GENTLEMEN,

In repeating on behalf of the Government of India the welcome extended to you last year at Madras, I desire to express our obligation to Local Governments and Administrations for having deputed so large a number of official and non-official delegates to this our Third All-India Sanitary Conference. Our numbers this year nearly double those of our last meeting and we have had from want of space to refuse several applications to attend. This fact and the consideration that, since our last meeting, provincial sanitary conferences have been held both in the Punjab and in Bihar and Orissa are, I think, reassuring indications not only of the value of these conferences, but also of the growing attention and interest that sanitation is eliciting in India. Nor is this interest confined to British India. To-day for the first time we are honoured by the presence of a foreign delegate in the person of Dr. Froilano de Mello who has been deputed to us by the Government of Portuguese India. I offer him our heartiest greetings and thank him for the two very interesting papers which he has contributed towards our discussions. Then I desire to welcome two eminent visitors to the Conference, Sir Malcolm Morris, who needs no introduction to you, and Sir Edward Buck who has given his life to the service of India.

At the last conference the opinion of the delegates was equally divided as to the relative advantages of Calcutta and Lucknow as the place of this year's meeting. Our decision in favour of Lucknow was influenced by the following considerations :—First, the two preceding conferences had been held in presidency cities where the conditions are very different from those obtaining in large mofussil towns like Lucknow. Secondly, Lucknow is a town to the improvement of which the Local Government and the local authorities have devoted much attention. And thirdly, Lucknow is within easy reach of three great pilgrim centres —Hardwar, Benares and Allahabad—to all of which places we hope to arrange for visits of inspection. As practical sanitarians you will find Benares to be full of interest from the point of view of its schemes for improving congested areas, its complicated sewage system and its co-operative dairy, whilst at Allahabad you will have an opportunity of studying the sanitary arrangements made to meet the requirements of the vast concourse of pilgrims now assembled there for the Magh Mela. The results of the conference will, I trust, justify the selection of its locale. If so, it will be in no small measure due to the admirable arrangements made for us by the distinguished Lieutenant-Governor of the United Provinces, Sir James Meston, and his officers. I desire to tender to them our respectful and grateful thanks. In particular I may mention the very heavy burden cheerfully undertaken by Major Harriss,

Sanitary Commissioner, and Major Selby, Principal of King George's Medical College, Mr. fforde, Deputy Commissioner, Rai Ganga Prasad Varma Bahadur, Vice-Chairman, and Mr. Botting, Secretary of the Municipal Board.

The year's retrospect shows steady advance in many directions. We may not—we must not—be satisfied with the present rate of progress, but there are no short cuts to the ends which we have in view. We have arrayed against us the habits and prejudices of centuries. We cannot in the land of the ox-cart get the pace of the motor-car. If ardent spirits are fretful at the rate of progress, they should at least realise that there has recently been greatly accelerated achievement and that there is a sanitary awakening which none can justly gainsay. In both hygiene and research the results give ground for hope.

In regard to the sanitary services four appointments of Deputy Sanitary Commissioner have been added to the eight new appointments sanctioned in 1912. The twelve new appointments have been allotted as follows :—

Three to Bengal,
Two each to Madras, the United Provinces, and Bihar and Orissa, and
One each to the Punjab, the North-West Frontier Province, and Burma.

Of these appointments, three are reserved for the present for officers of the Indian Medical Service, and the remaining nine are open to medical men recruited in India of whom eight —all Indians—have already been appointed. In addition, 39 first class and 104 second class health officers are to be appointed to the municipalities. In order to assist Local Governments in organising the service without delay a recurring grant of 2·66 lakhs of rupees has been sanctioned from Imperial revenues, in addition to a grant of Rs. 25,560 per annum to the North-West Frontier Province. The Government of India are meeting the cost of the new appointments of Deputy Sanitary Commissioner on the scale sanctioned for Indians, and are giving a subvention amounting to half the pay of first and second class health officers. Special attention is also being paid to the training of sanitary inspectors. Bengal, the United Provinces, Punjab, and I believe Burma, have followed the example of Madras and Bombay, and it is hoped that training classes will be opened soon in Bihar and Orissa. The necessity of enlarging the Bacteriological Department has also been recognised and the Secretary of State has already been addressed on the subject. I hope also that the Secretary of State will soon be addressed regarding an increase in the sanitary engineering staff.

I next turn to the disposal of the grants for sanitary and anti-malarial schemes. The non-recurring grants for the purpose of urban sanitation in 1913-14 amounted to 150 lakhs, or £1,000,000 sterling, exclusive of a sum of 13¾ lakhs for special schemes in the North-West Frontier Province, Delhi, Bangalore, Indore, Quetta and Mercara. The recurring grants for sanitation in the same year amounted to 45 lakhs, or £300,000 sterling per annum of which 5 lakhs was reserved for research and anti-malarial projects. The remaining 40 lakhs recurring and the non-recurring sum of 150 lakhs have been distributed amongst the different provinces in lump sums. Schemes for the improvement of rural sanitation are not yet sufficiently advanced to justify Imperial grants, but they are receiving attention. In the provinces which benefited by the transfer to district boards of the entire net proceeds of the land cess to the amount of some Rs. 82 lakhs or over £546,000 sterling a year, there should be no difficulty in financing sound schemes of rural sanitation. It is hoped that considerable sums will be set aside for the improvement of rural water supplies, for anti-malarial measures, for the protection of grain stores and for general sanitation.

To those of little faith I would commend the fact that since the new department was formed in January 1911 Imperial grants made for sanitation, research, and anti-malarial measures have amounted approximately to Rs. 4,55,74,000 or £3,038,266 sterling, of which Rs. 49,50,000 or £330,000 are recurring and Rs. 4,06,24,000 or £2,708,266 are non-recurring. These large subventions have been made, I may claim, without any interference in the domestic affairs of Local Governments. All this has thrown a heavy strain of work on the department and I desire to acknowledge the able and untiring services of Mr. Ludovic Porter and Kunwar Maharaj Singh. I can only repeat the great debt under which we all lie to Sir Pardey Lukis and Major Robertson.

During the year the following grants have been made by the Research Fund for anti-malarial measures :—

	Rs.
(1) Part contribution to anti-malarial measures at Palwal in the Punjab	14,000
(2) To complete schemes at Saharanpore, Nagina and Kosi	2,00,000
(3) For similar purposes in Ennore	58,700
TOTAL ..	2,72,700

No grant has yet been made for the Meerut and Kairana schemes which are still under consideration. Other grants made from the Research Fund have been :—

	Rs.
(*a*) For equipping research laboratories of the Calcutta School of Tropical Medicine, the foundation stone of which will shortly be laid by His Excellency Lord Carmichael	1,00,000
(*b*) For improving the laboratories and teaching accommodation at the Central Research Institute, Kasauli	16,000
(*c*) For an elaborate experiment in water filtration at Benares	1,50,000

(*d*) A grant of Rs. 2,000 to Captains Patton and Cragg to assist them in producing a treatise on medical entomology which is now in the press.

(*e*) A contribution of £500 per annum, for a period of three years, to the Imperial Bureau of Entomology, for the investigation of noxious insects.

(*f*) Grants of Rs. 1,000 each to the Bombay Bacteriological Laboratory for a practical experiment in the disinfection of grain in bulk and to Professor McMahon of the Canning College, Lucknow, towards an investigation into the chemical composition of milk in the United Provinces.

Since the inception of the Research Fund we have received in grants 16,00,000 and disbursed 14,35,000 in accordance with the advice of our Scientific Advisory Board.

The actual work carried out during the year under the auspices of the Indian Research Fund Association and of the various provincial administrations has been considerable. There are at present nine medical officers working on special malarial inquiries in seven provinces. You will also be glad to hear that the Secretary of State has sanctioned the establishment of a Pasteur Institute at Rangoon, the Director of which will combine bacteriological and serological research with his routine work.

I am profoundly impressed by the possibilities which research generally and bio-chemistry in particular are opening up to us. I hope

that before many years have passed we shall have in different parts of India research institutions which will attract scholars from all quarters of the globe. Without anticipating the proceedings of the research section of this Conference in regard to special investigations, I may say that they comprise inquiries into the causation and mode of spread of kala-azar, dysentery, relapsing fever, cholera and goitre. In all probability the majority of these inquiries will be continued during the coming year. As regards the immediate future it is proposed to institute at Poona an investigation with reference to the fixation of bacteriological standards of purity for drinking water. Inquiries will also be made into the etiology of diabetes, leprosy, and the fevers of uncertain origin. Although diabetes is not strictly speaking a " tropical " disease, it leads to the death of so many valuable lives in India that an inquiry into its causation and prevention has become necessary. This inquiry will, however, be one of considerable difficulty as the disease does not attack the class of people who come to hospital for treatment, being confined almost exclusively to the richer and more intellectual classes, especially those who lead sedentary lives. In addition we intend to carry out at Benares an elaborate practical experiment in water filtration with the object of ascertaining the best methods of silt-removal and determining the relative merits under varying conditions of the different types of mechanical filters and of sedimentation both with and without the addition of chemicals.

The treatise on medical entomology by Captains Patton and Cragg which will be published shortly, will I trust prove of great assistance to all workers in this fascinating branch of medical research. We have also engaged the services of an Indian gentleman, Dr. Awati, as medical entomologist. He has been working under Dr. Maxwell Lefroy at South Kensington, but is expected to arrive in India by the end of this month.

I recommend to your careful perusal the able reports by Major James on the protection of India from yellow fever and on the practicability of stegomyia reduction in Indian seaports which were published in the second number of the Journal of Medical Research. It is gratifying to learn that in Major James' opinion there is no immediate danger of importation of infected mosquitoes into India after the opening of the Panama Canal. At the same time Major James urges that this does not justify inaction and points out that a continuous water supply is an essential preliminary to any attempt to reduce the numbers of stegomyia mosquitoes in our seaports. During the last year Major James has been on deputation with the Ceylon Government and has carried out an extensive anti-stegomyia campaign in Colombo. I deeply regret that he has now been stricken by serious illness and must proceed to England as soon as he is fit to travel. I am sure that you will all join with me in wishing him a speedy recovery and a quick return to the scene of his useful labours.

The new " Indian Journal of Medical Research " has now appeared and its third number will the day after to-morrow be in the hands of the delegates. It has met with a most cordial reception not only in India, Great Britain and the Colonies, but also on the Continents of Europe and America and its circulation is already very large and is steadily increasing. If you will consider the style of its production, you will understand that at the low subscription-rates now charged it will not be a financial success unless our subscription list is considerably increased. It is at present financed by the Indian Research Fund Association, but we have no right to count on such support for an indefinite period. I trust therefore that you will all do your best to increase its circulation. Here I may mention that all the papers presented to the Conference have been printed in such form as will enable them to be issued as supplements to the Journal. In this way they will secure a far wider circulation than is possible when they are published merely as appendices of an official

report. They will, moreover, be issued shortly after the conclusion of the Conference and will thus be in the hands of the public sooner than was possible under our previous arrangements.

I attach great importance to the work of the provincial pilgrim committees with whom the Sanitary Commissioner with the Government of India is zealously co-operating. The great pilgrim centres are foci of epidemic disease and sanitary improvements in them will add much to the health and the comfort of the general population. In this connection I may note the important bearing of Major Greig's researches into cholera. During the winter of 1912-13 the Pilgrim Committee toured extensively in the United Provinces. Their report is now under consideration. One of the most important recommendations of the Committee was the improvement of the great Badrinath Pilgrim Route, regarding which a most interesting report has been written by Mr. G. Adams of the Indian Civil Service—it will be found in the January number of the Indian Journal of Medical Research. The Government of India have made a grant to the Local Government of 6 lakhs non-recurring to be spread over 5 years, and 20,000 recurring for this object, and it is hoped that the Local Government will be able to meet the balance required to complete the scheme from provincial revenues. These improvements should be greatly appreciated by many thousands of pilgrims journeying from all parts of India.

I now turn to the proceedings of the Conference. The only change in procedure this year is that for administrative convenience: malaria is now dealt with in the research section instead of our holding a separate malarial conference.

An analysis of the agenda paper is interesting. There are no less than twelve contributions on problems in connection with malaria. No subject has attracted so much attention. Urban and rural water supplies are treated of in seven valuable contributions and milk supply in six. Four papers deal directly or indirectly with town-planning, and four also with the important subject of vital statistics. The range covered by these papers is very wide, and time will not permit of my dealing with them in detail. But I must allude briefly to a few of them, and I would first direct your attention to the three important papers on *bonificazione* which are on the agenda for discussion this morning. This method is said to have given good results in Italy, and the papers which, as you know, were presented to Government some years ago, are reproduced here in order that the question as to how far the method is applicable to India may be thoroughly ventilated and discussed.

Another important subject for discussion is the question of the milk supply. It is obvious that we must fix standards of purity with reference to the Food and Drugs Act, but the question is complicated by the fact that milk in India is often a mixture of cow's and buffalo's milk. There are, moreover, administrative difficulties in connection with religious and caste prejudices and with the possibility of raising the price beyond the means of the poorer classes.

As regards town improvement, you will have opportunities of seeing examples of this in Lucknow before the discussion on this subject takes place. You have also before you a technical and elaborate paper by Mr. Orr which throws much light on the difficult subject of the regulation of light and air—points which are of vital importance in view of the steady increase of tuberculosis amongst the urban population.

Then you have three very important papers on the subject of plague. Those of Captain Kunhardt suggest a possible new departure in our plague policy. In one of our resolutions last year we directed attention to the necessity for carrying on active anti-plague measures in certain selected villages during the quiescent period. Captain Kunhardt's present report shows us how to select the villages which require special attention. His suggestions are now under consideration, and it is possible that we may decide to carry out an experiment of this nature

on a large scale under the auspices of the Research Fund. The paper from Parel on grain disinfection reports the results of the experiments for which we gave a grant of one thousand rupees. These experiments are of considerable value in view of the rapidly accumulating evidence as to the part played by grain in the introduction and spread of plague not only in India but also in Java, Manila and the Straits Settlements.

Another paper, to which I would draw special attention, is that of Major Cook Young on the incineration of rubbish and night-soil in Delhi city. Those of us who live in the vicinity know what a wonderful effect this has had in mitigating the fly-nuisance. Our experience in this matter illustrates in a practical manner how large a portion of the discomforts which we suffer and the dangers to which we are exposed in India are due to defective scavenging.

Lastly, I wish to refer to the lantern exhibition of type-designs from all the different provinces, which, it is hoped, will afford a valuable opportunity for exchanging views and discussing local peculiarities and difficulties.

Research in all its many branches is lifting the veil that hides the secrets of disease and mortality, but we shall not fully benefit by its discoveries until the people are educated to receive them. In a resolution dated the 21st February 1913 the Government of India commended to Local Governments a thorough enquiry into the teaching of hygiene in schools and colleges and attention to the personal hygiene of the students—a subject upon which Rao Sahib Ganesh Nagesh Sahasrabudhe and Rao Bahadur Gopal Das Bhandari have written instructive papers. We are also most anxious to enlist private co-operation and have reason to hope that the Indian Council of the St. John Ambulance Association will come to our assistance. Practical details of any scheme eventually adopted will be worked out when the reports of the provincial committees of enquiry have come in. At present the general idea is to impart instruction in first aid and domestic hygiene in certain schools, and to encourage active workers of the Association to afford assistance in the inspection of pupils and the school premises. It has also been suggested that special training in hygiene should form part of the curriculum for teachers. Any such scheme, however, will leave the adult population untouched. In order to reach them, it is proposed to organise under the auspices of the Indian Research Fund Association a Central Bureau where a sufficient number of good lantern slides, models, pictures and skeleton lectures could be stocked. These would be issued to the several provincial Sanitary Commissioners to be distributed by them on loan to health officers and medical men for the purpose of popular lectures, to the staff at the different fairs, and to the staff of travelling dispensaries. With the sanction of the Government of India the United Provinces Government has recently created and financed 26 additional travelling dispensaries in the United Provinces, and financed the employment of three officers of the Indian Medical Service to supervise them at an estimated cost of 89 thousand rupees per annum. Small exhibitions might also be organised and bacteriological leaflets be distributed at religious melas. Nor can we stop here if we wish to achieve complete success. Colonel Firth speaking before the United Services Institution at Simla, and simultaneously Sir Pardey Lukis delivering the inaugural address at the London School of Medicine for Women—the one from the military and the other from the civil standpoint—expressed their strong conviction that we shall never make any real advance in domestic or personal hygiene until we have convinced the women of the country as to its necessity. This object we can achieve in two ways. The one is by encouraging medical women to preach the gospel of health inside the zenana and to organise purdah parties at which they will give lantern demonstrations, for which purpose we shall be glad to lend them the necessary apparatus. The other method is by a cautious development of the system of employing nurse district visitors and sanitary inspectresses. You have before you

an excellent paper on this subject from Madras where the experiment has been in progress for the last six months, and I understand that similar useful work has been inaugurated in Bombay by Dr. Turner who, I am glad to learn, is giving us the benefit of his great experience in a work on sanitation in India which is shortly to be published. I trust that the two papers which I have mentioned will lead to a full discussion of the whole subject, for I am convinced that if we can succeed in working out a practical scheme it will have a lasting effect upon the welfare of future generations, both by increasing their knowledge of preventive measures and by improving their general standard of health and physique.

You will thus recognise that essential and far-reaching systems of sanitary education are now in the air. I hope that we shall soon be able to publish a Resolution on general sanitary policy and address Local Governments with a view to the working out of definite schemes. We have before our eyes the remarkable achievements on the military side by the service so ably directed by Sir Arthur Sloggett. The military conditions are not comparable to those with which we have to deal. We have to handle not small numbers of adults under military discipline in sanitary surroundings, but many millions of men, women and children living in most insanitary surroundings under little or no control. We have to carry the people with us and there are limits to the powers of education which no amount of money can altogether remove. But we can do much and I know this—that you will press forward patiently, but persistently, with long vision and high sustaining hopes, and, believe me, gentlemen, you will succeed.

At the close of the Presidential Address, the Conference adjourned and reassembled in the Examination Hall. Lieutenant Dr. Froilano de Mello, the delegate of the Government of Portuguese India, then spoke as follows :—

Monsieur le President, Messieurs et honorés congréssistes.

Dans cette salle et au milieu de cette assemblée où toute une troupe de savants se trouve réunie pour les travaux de cette conférence nous venons d'ecouter les éloquentes paroles de bienvenue que nous ont été addressées par les vénérables levres de Sir Harcourt Butler et chacun a dû sûrement sentir une certaine fierté en sachant que ces éloquentes paroles s'addressent à chacun de nous. Moi alors j'en suis particulièrement touché et les délicates attentions que M. le President a eues envers ma personne, je les accepte non comme dirigées à ma personnalité, trop petite pour figurer à la tête de tant de noms illustres dont je suis heureux de faire ici connaissance, mais pour la nationalité que j'ai l'honneur de representer, la nation portugaise, votre amie et alliée qui a toute sa foi dans son passé célèbre et toute son espérance dans son avenir.

Au moment où le discours de M. le Président sera lu par mes confrères portugais, à l'Inde comme au Portugal un frisson d'enthousiasme passera dans les âmes de mon pays ; on se sentira fier de l'accueillement que le representant du gouvernement portugais a reçu de la jamais démentie gentillesse anglaise et j'ai pleine foi que l'entretien amical d'aujourd'hui sera pour nous une nouvelle voie ouverte pour la recherche scientifique, aux colonies surtout où les portugais ont tant de relations avec la puissante nation Britannique et où quelques-uns de nos médecins se sont devenus célèbres, soit dans le champ d'Hygiene, soit dans celui de la Parasitologie.

Au moment où je parle, je sens bien que la voix me manque pour qu'elle soit digne de vous et digne de moi. Ne suis-je pas au milieu d'infatigables scientistes que nous nous sommes habitués à vénérer de très loin au travers les brillantes conceptions, les brillantes découvertes que nos étudiants savent par coeur, parceque les noms de leurs auteurs n'appartiennent plus à une nation, une fois qu'ils sont si grands qu'ils appartiennent à l'humanité entière. La Patrie de la science, Messieurs, est l'Univers tout entier, et heureuse la nation anglaise qui possède des

fils dont tous les pays disputeraient avec plaisir le berceau et qui font l'orgueil de leur Patrie. Elle résume donc par elle-même une bonne parcelle de cet univers scientifique.

Eh bien, malgré que la voix me tremble, en sachant que l'esprit de Ronald Ross est présent à cette conférence, Ronald Ross qui avec Laveran peut être bien considéré le fondateur de la Parasitologie tropicale, malgré qu'autour de moi je vois des savants d'envergure de Leonard Rogers, Glen Liston, Donovan, Percival Mackie, Christophers et tant d'autres dont les noms m'échappent à présent et qui voudront bien excuser à un étranger de ne pas pouvoir citer les leurs, je vois les yeux intelligents et pleins de bienveillance de Sir Pardey Lukis, qui m'animent à dire que je ne parle ici que pour vous presenter mes hommages personnels et pour vous assurer de la part de vos confrères portugais l'expression de la plus enthousiaste admiration qu'ils ont pour l'oeuvre scientifique qui ont accompli les sujets de la très haute et très puissante Majesté Britannique, Empereur des Indes.

The PRESIDENT explained that as all the papers had been circulated to delegates they would be taken as read. The Conference then proceeded to discuss the various papers regarding " The Italian system of reclamation of land by silt deposit with reference to the mitigation of malaria."

The following are summaries of the papers.

(1) REPORT ON THE CONTROL AND UTILIZATION OF RIVERS AND DRAINAGE FOR THE FERTILIZATION OF LAND AND MITIGATION OF MALARIA.*

BY

SIR EDWARD BUCK, K.C.S.I., LL.D.

The utilization of silt for the fertilization of land has been carried out on an important scale in Italy since the twelfth century, many hundreds of square miles of unwholesome depressions of poor soil having been rendered healthy and fertile by silt deposit previously to the unification of Italy.

Since the unification in 1862, the Government has undertaken a still wider campaign against malaria throughout Italy by the agency of silt deposit combined with drainage. There are now 249 projects in hand, covering an area of 4,300 square miles, of which nearly half are approaching completion.

The annual expenditure on these projects has increased from about 15 to about 50 lakhs of rupees a year ; 9 million sterling has been expended in 42 years. Earlier operations have, some of them, been unremunerative owing to inexperience and political interruptions. But more recent works have, many of them, been highly profitable, returning 20 per cent. on capital outlay.

The results have been achieved by securing the control of the rivers and of the drainage system in the plains throughout the country.

In addition to the operations conducted by Government a large number of works are carried out by associations of private owners with or without official assistance. But whereas the primary object of the Government is expulsion of malaria, followed by fertilization of land, the primary object of the private owner is agricultural improvements, followed by improved sanitation.

During the last century a system has been developed of securing the control also of rainfall and drainage in the hills, by which erosion is prevented and ravines and depressions are converted into fertile belts of good soil.

Can Italian methods be usefully applied to India ? As regards low-lying lands in the plains there are two distinct issues : (1) the expulsion

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or diminution of malaria, (2) the fertilization of soil. The first object can be partially effected by drainage, and it is noted that a large drainage scheme for this purpose is under contemplation in Bengal. But to use the Italian expression, *the lowering of the level of water should be combined with the raising of the level of the soil.* How the two systems are combined in Italy requires a study of Italian methods (which are the result of centuries of experience and development) by competent engineers.

At a recent Agricultural Conference in Italy it was "resolved," that although drainage might be desirable for the rapid conversion of unwholesome into wholesome tracts, it would be a "grave error" not to follow drainage, wherever possible, with silt deposit.

The virtues of silt deposit are not unknown in India. In 1893, I was permitted to issue a circular enquiring how far the practice of using silt deposit prevailed. The answers imply that in some parts of the country the cultivators use it with or without official help, but that in most Indian districts little or nothing is done in this direction, and that nowhere was there any comprehensive scheme for the control of rivers and drainage with the object of preventing malaria or of fertilizing land.

Similar evidence was given regarding the control of drainage in hills and ravines for the prevention of erosion and for the fertilization of land. Sporadic work of the kind had been done in various places with or without official help, but no comprehensive scheme had been undertaken in any province. A commencement on an important scale seems, however, to have been made in the Bombay Presidency, where several lakhs have been granted for the control of drainage in hills and ravines as a famine work.

Such works were recommended for famine relief in the first Famine Code, but have not been hitherto seriously utilized. It would seem desirable that they should be included in the programmes of famine relief works.

The successful system referred to in paragraph 6 developed in Italy for the control of drainage in hills and ravines is novel and unknown in India. This also seems to require study in Italy by competent engineers.

Another matter which is considered of importance by the agricultural authorities in Italy is the formation and training of corps of agricultural engineers as has been done in Germany and more recently in France. This question seems to deserve consideration in India.

Next to water, the great want of India, especially of Upper India, is manure. Oilcake and bones, two of the principal manures of Europe, are exported; stable manure is most of it burned. Chemical manures are too costly. It would seem to be a "grave error" not to utilize river silt, wherever available, as an additional manure supply. Both from Italy and India it is reported that good silt deposit requires no other manure for ten years.

The immediate measures suggested are :—

(1) The continued analysis of silt in rivers and canals when in flood after heavy rain.
(2) The deputation of a competent engineer or engineers for the study of methods in Italy.
(3) The construction of drainage maps, on the inexpensive system explained in the report.
(4) The general discussion of the questions involved at the annual agricultural conference in February 1907.

Further questions may be brought under consideration in later years, such as :—

(5) Whether the silt of Indian rivers and canals, especially in sub-Himalayan tracts, can be profitably utilized.
(6) Whether notoriously unhealthy tracts, such as the Terai, can be treated on Italian methods for the checking of malaria.

(7) Whether schemes can be prepared for inclusion in famine relief programmes.

(8) How far existing canals can be utilized for the distribution of fertile silt.

(2) REPORT ON UTILIZATION OF SILT IN ITALY.

With Supplementary Note *

BY

MR. C. H. HUTTON.

As a result of the recommendations of Sir Edward Buck, K.C.S.I., the author was sent on deputation to Italy to study the methods employed for the utilization of silt for the mitigation of malaria and the fertilization of land.

The engineering and agricultural aspects of the question are fully described and discussed.

The term *bonificazione* means, in a general way, the improvement of the land, either from an agricultural or hygienic point of view, or from both together. The works themselves are called *bonifiche*, and consist essentially in the hydraulic regulation or systematizing of the tract of country to be improved, by regulating the courses of rivers and torrents, by systematizing their mouths, by erecting embankments to prevent inundation, by raising the level of low-lying lands, by filling up stagnant pools of water with silt derived from the turbid waters of rivers or torrents, by means of pumping, by filling up borrow pits along the line, roads, railways or canals with silt wherever possible, or, if not possible, by providing proper facilities for drainage.

By the Italian Act of 1900 the works are divided into categories.

(*a*) The more important works of drainage and *colmata* (the term *colmata* means the process of depositing silt on low-lying lands) which have in view a great hygienic or agricultural amelioration of the condition of a tract of country. Such works are carried out by state or provincial agency.

(*b*) Works in which private interest is either dominant or exclusive.

The methods of financing the schemes and the various factors to be studied in the preparation of projects are described.

Section II of the paper gives detailed descriptions of the *Bonificazioni* works actually visited by the author at Ostea, Foggia, Capua, Grosseto, Revenna and Ragazzenna.

Section III is devoted to a description of the system of reclaiming ravines and stopping erosion in the hills, a system known as *colmata di monte*, which has for its object the utilization of the force of the waters for the removal of the objectionable ruggedness, whether concave or convex, and for modifying or rendering the slopes more uniform.

In Section IV the author discusses the conclusions to be drawn from the Italian works. The question of the applicability of such works to India is examined, and the silt-carrying capacity of Indian rivers compared with Italian rivers.

Indian rivers do not contain anything approaching the volume of silt to be found in Italian rivers. In the Jumna-Ganges Doab any large schemes for reclamation would not prove financially successful. It is quite possible that in some parts of India, particularly towards the sea-coast, where the physicial conditions may approximate more closely to those found in Italy, large reclamation schemes are practical.

In reference to the question as to whether notoriously unhealthy tracts such as the Terai can be treated on Italian methods for checking malaria, the author concludes, at all events in the Kumaun-Terai, where he has had much experience, that such methods would be unsuccessful.

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Still much could be done in other ways to mitigate the evils of malaria.

As regards *colmata* in the hills, it is doubtful whether it is generally adaptable to India, but it is worth a trial, especially in the neighbourhood of large towns where intensive cultivation with irrigation and manure can be practised. There are also many places in the ravines bordering on the Jumna where the land could be built up with a series of silting basins as described in the text. The author is convinced that the problem to be solved in many parts of India is not that of capturing the silt after it has found its way into torrents or rivers, but *to prevent it getting there.*

Sir Edward Buck has submitted as one of the questions for consideration, whether schemes can be prepared for inclusion in famine relief programmes, and the writer considers that a system of village relief works for the embanking and terracing of fields in tracts like those bordering on the Jumna would be eminently suited as famine relief works.

(3) REPORT ON THE COLMATE DI MONTE OF ITALY.*

BY

MR. F. CLAYTON.

The injurious action of rainfall on hill-sides in washing off the good surface soil and forming ravines and landslips, is an evil that has long claimed attention in Italy. Many attempts at rectifying the evil have been made by methods of sub-soil drainage, contour drainage, and systems of contour ploughing, with the banking up of depressions and ravines. By these means the irregularity of the hill-sides is reduced and cultivation of the slopes between contours is made easier. When the minor depressions have been filled up the land is then considered to be systematized.

The detailed description of these processes and the author's personal observations are given, and the text illustrated by diagrams and photographs.

The important question is raised as to how far the Italian methods of reclamation and improvement of hill-sides can be applied to Indian conditions. The rainfall in India is so much greater in intensity that, although to some extent the methods are capable of application, they must be more expensive owing to the masonry works that would be necessary. Nevertheless, they could be usefully adopted in the gradual reclamation of the ravines along the borders of the *khadirs* of many of the larger Indian rivers.

(4) NOTE ON THE SILTING UP OF THE BISTUPUR BHIL AT BERHAMPUR.

BY

MAJOR W. W. CLEMESHA, I.M.S.

The flood water of the Bhagirathi river is admitted into the Bistupur bhil and after depositing its silt is drained off.

The note gives the extent of the annual depositions of silt, and it is estimated that it will take 15 years to silt up the bhil entirely, and render the area available for cultivation throughout the year.

SIR EDWARD BUCK, in introducing his paper, said:—The reports on the table by myself and Mr. Hutton indicate sufficiently the great work accomplished in Italy during recent centuries, and being carried

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on with greater persistence than ever at the present time, with the primary object of mitigating malaria and the secondary object of creating fertile lands.

One of the greatest, if not the greatest, of Italy's geniuses, Leonardi da Vinci, led the way by pointing out in the 53rd chapter of his great work on the uses of water, how the soil of the higher levels should be spread over the lower levels in order to render them fertile and purify the air. This is the principle upon which all subsequent operations in Italy have been based. Purifying the air meant, though Leonardi did not know it, the getting rid of the mosquito. Obviously the first step was to harness the rivers and to control their waters so as to oblige them to deposit their silt, whenever it was worth depositing, on malarious depressions.

In 1906 I was allowed by the Government of India to make a tour round Italy in order to see what had been and what was being done. It was found that the extent of country under recent and present treatment was 4,300 square miles, independent of an unknown area of some thousands of square miles dealt with by drainage or by deposit of silt in past centuries. From one celebrated inland valley (Val di Chiana) of 800 square miles, it was officially reported at the end of the 18th century that malaria had been finally expelled. "All the transformations have been due," it was written, "to the natural deposit of silt spread over the land by lateral streams directed more or less by man." At the time of my visit in 1906 there were in operation just 249 separate works in different parts of Italy.

Naturally what I had seen in my tour led to the question how far similar work could be undertaken in India, and I suggested to the Government of India that a competent engineer should be sent to examine the Italian system from an engineering point of view, a suggestion which led to the deputation of Mr. Hutton whom I had the pleasure of accompanying round Italy. Eventually the Government of India committed the task of having experiments tried, to the Government of the United Provinces, and Mr. Hutton, whose excellent report is before you, will be able to tell you to what extent these have been carried out. As far as I can learn, they have as yet been confined to what are called silt traps designed to fill up depressions on the borders of canals.

In discussions on the subject of harnessing the rivers of India on the Italian system I have often been met by the objection that the game would not be worth the candle, that the floods of the monsoon are less easy of management, and that the cost of harnessing would be excessive. It could not, however, be urged that the smaller rivers could not be brought under control in view of the fact that our splendid engineers have successfully "harnessed" (I commend that Italian word) the mighty rivers of North India. The objection is entirely one of cost. I venture to contend that this objection cannot carry much weight until reasonable experiments have proved it to be valid.

The primary object of the Italian operations has been the extinction or mitigation of malaria. The fertilization of land which holds the first place in Leonardi da Vinci's treatise is not recognised by the Italian Government as an object justifying state action in the temporary occupation of private estates. But the health of the people is considered paramount above all other considerations and when there is malaria, Government steps in and takes up the land until it is cleared of malaria. So it should be in India if, as in Italy, the money can be found. Fortunately experience in Italy has now led to a remunerative system and there are strong reasons for believing that such might be the case in many malarious tracts in India also.

The primary, if not the sole, object of Indian canals has been, and is, irrigation. Fertilization of land and mitigation of malaria have not been thought of. On the contrary, land has been impoverished, productive powers of soil lessened, and malaria increased. It is unfortunate

that when the earlier canals were planned no detailed maps of the drainage of the country existed, and that what was called the fir tree design was adopted without knowledge of the harm that would be done by interference with the natural drainage. In the fir tree plan, branches were led out from the trunk canal every 3 miles or so in parallel lines, without regard to the surface drainage of the country. I may give as one example (there are many others) my own experience on 30 miles of the Ganges Canal, in a tract in which I was settlement officer. The fir branches traversed obliquely the natural drainage of the country and continually caused swamps (with consequent malaria) which was ruining many villages. I represented the matter to Government with the result that the existing branches were broken up and new ones constituted on minor watersheds. I have a special object in drawing attention to this particular case because my discovery of the many places in which similar swamping and increase of malaria occurred, was due to my having had drainage maps made in every village on the simple and inexpensive plan explained in Appendix D of my report. Possibly the maps indirectly saved in this case many lives.

It may be noted that on page 24 of my report before you, the suggestion was made that similar maps should be made throughout the provinces. I am not aware, however, that any steps have been taken in this direction. But I am quite sure that no important scheme of drainage control can be undertaken in connection with the mitigation of malaria until detailed drainage maps are forthcoming. What I would now venture to suggest is, that not only should these maps be made, but that they should, when made, be utilised for the construction of a malaria map based on the statistics of the greater or less prevalence of malaria in each village or group of villages. These data combined with the drainage map would quickly indicate tracts in which a higher percentage of malaria cases was associated with surface depressions. It would then become the duty of the engineers to consider whether the depressions could be silted up. The feasibility of constructing such maps at an insignificant cost was, as indicated in Appendix D of my report, proved by the application of the system to the whole of the Cawnpore district, some 2,000 square miles, by Mr. F. N. Wright, Settlement Officer, and though his map has been lost, a section of it, which will serve as an illustration, survives in Colonel Clibbon's manual. It is obvious that such maps would be useful for many administrative, engineering, and agricultural purposes independently of a malaria survey.

I notice for instance that in an interesting paper on drainage for agricultural purposes, Professor Howard of Pusa insists on the necessity of such maps, advocating, indeed, the system to which I have referred. I venture now to hope that the support of this Conference will be given to the furtherance of the scheme.

Reverting to the wider project of harnessing streams on the Italian system, it is no doubt wise, before making attempts on minor rivers, to commence by utilizing the elaborate canal system by which the waters of the greater rivers already harnessed are distributed—a beginning has indeed been made. But I would represent that the scientific organization so splendidly arranged in Italy has not as yet been systematically established in Indian experiments. It will be seen from the reports of Mr. Hutton and myself, that the key to the Italian success is the seizure of the earliest silt brought by floods after rainfall, and that the greatest care is taken to test the character and value of every ounce of silt deposited by river or canal. It is of course, from a medical point of view, immaterial whether a depression is filled up with fertile soil or with agriculturally useless sand. But it is obvious that the enormous funds required for any extensive works would never be granted by the financial departments in India, unless there were some prospect of a financial return. Italy, it is true, scorned expense. The health of the people was the paramount consideration. But the experience and wisdom of the engineers have

now succeeded in making the operations profitable, but only on condition that the upper stratum of silt deposit is good and fertile soil.

Major Buck, with whom I recently inspected a silt trap of nearly a square mile in the district of Karnal, of which he is Deputy Commissioner, will give you figures which indicate that an expenditure of ¾ of a lakh would, if the principle of good silt at the top be considered, give a return of 5 to 10 per cent.

That there is an enormous quantity of good soil washed down the Himalayan slope by the earlier floods; that nearly the whole of it is carried into the larger rivers and sea; that it is lost to the agriculturists who, as Professor Howard has written, want nothing so much as this very manure, are facts which are sufficiently patent. So far as this good soil can be saved it will add to the wealth of the country, and surely every attempt ought to be made to secure it, especially if at the same time it can be utilized to keep down mosquitoes and malaria within restricted limits. Mr. Hutton has dealt elaborately and instructively with the problem of obtaining silt from the distributaries of canal water in Upper India and fully recognises the necessity of using the best of the soil which they carry. But I am disappointed with his, to me unexpected, conclusion, that the earlier floods, richest in fertilising silt, cannot be used because the canals are then being fully worked for other purposes. But this is just the silt we want. This is just the silt for which the Italians eagerly watch when showers fall in their little mountains. It is not, however, a question which there is time to discuss further now. I can only urge that whenever good silt is brought down from our hills it should be as far as possible utilized, and that the permanent advantages of health and fertility should not be lightly subordinated to the temporary advantage of irrigating crops at a season when the principal harvests have already been gathered. But I congratulate Mr. Hutton in having given such close and earnest attention to the subject.

In conclusion, I hope that I shall not be considered impertinent if I suggest that one or two medical men should be allowed to visit Italy and see for themselves what magnificent results have been obtained in that country. Should this step be taken, I shall be glad to be permitted to give assistance in the way of information and introductions.

In the meantime, I trust the Conference will join in supporting the proposal for drainage maps as a necessary basis for a satisfactory malaria survey, and will recommend that there should be some central authority responsible for maintaining the promotion of progress in *bonificazione* throughout India.

THE PRESIDENT said he had just received from Professor Howard of Pusa a brief note on some work that he had done there, and requesting that he might be allowed to explain briefly the experiments he had been conducting at Pusa.

PROFESSOR HOWARD: One of the great arguments against drainage as an anti-malarial measure in rural India is the expenditure involved. If, however, it can be shown that drainage increases very materially the crop-producing power of the land, and can be carried out at a small cost, the financial objections disappear. Further, a drainage system which adds to the income of the cultivator, and also increases the revenue-producing power of the country, will be as popular an anti-malarial measure as can well be devised. In the present note an account is given of a system of surface drainage suited to the local conditions of considerable tracts of India. In Bihar the method has already been taken up at several centres and has proved of the greatest agricultural value.

The need of drainage in the monsoon tracts of India is very great. Every year the country sustains a large annual loss of crop due to the water-logging of the soil. This point is hardly realised at present, but it will be understood when it is remembered that most of the rainfall is compressed into four months of the year. Under such circumstances

the land remains wet for long periods at a time. The proper proportion of air and water in the soil on which fertility depends cannot be maintained. There is too much water and too little air, and in consequence, the fertility is destroyed, probably due to a loss of available nitrogen by denitrification.

The amount of loss of crop due to water-logging was determined at Pusa in the *rabi* season of 1910-11. One of three plots of wheat land was kept water-logged during the month of September and then allowed to dry. Afterwards the three plots were treated alike and sown with wheat in the ordinary way.

The yield in bushels per acre obtained was as follows :—

1. Plot water-logged in September only .. 15·55 *bushels.*
2. Normal plots (average) .. .. 31·79 ,,

Thus the effect of water-logging for a month was a loss of wheat of just over 16 bushels to the acre, or what is usually regarded as a full crop in this locality. The above is not an isolated example of water-logging, but has frequently been observed at Pusa and at other places in the Gangetic plain.

To prove that the loss of fertility which follows water-logging is due to a destruction of available nitrogen, a strip of land down the middle of the three plots was manured with nitrate of soda before sowing. The yields in bushels per acre on the manured strip were as follows :—

1. Water-logged in September, manured with nitrate of soda .. .. .. 25·17 *bushels.*
2. Non-water-logged plots manured with nitrate of soda (average) .. .. .. 31·22 ,,

Nitrate of soda, therefore, increased the yield of the water-logged area by 9·62 bushels per acre and had practically no effect on the normally managed plots.

These figures are of considerable interest to India. It requires no great imagination to realise what they mean to the country if any considerable area is in need of drainage in ordinary years. The losses due to water-logging can in many cases be prevented. Wherever surface drainage can be carried out, loss of crop due to water-logging need not occur. A method of drainage has been devised at Pusa for this purpose which is now being actively taken up in Bihar. The system consists in dividing up the land to be drained into suitable areas from one to five acres in extent. These areas are then surrounded by trenches and the edges of the ditches are put down in strips of grass about two feet broad, the level of the grass borders being about one inch above that of the field. The field ditches connect with larger trenches which act as small drainage canals and carry off the surplus rainfall either to rivers, nullahs or to the low-lying rice fields. The cost of digging the ditches and planting grass on the borders of the trenches is very small. To carry out the system a rough drainage map is essential. This can best be made by marking on an ordinary map the directions in which the rain runs off the land during the monsoon. This is a better and cheaper method than that of taking levels.

The advantages of this method of drainage are very great and are as follows :—

(1) Water-logging is prevented. A great increase in crop, particularly in the low-lying land, is at once obtained. This is illustrated by the continuous wheat plot at Pusa. This plot, which formerly gave poor yields of wheat, has gone up in crop-producing power since it was drained, and although cropped with wheat every year for the last seven years without manure, shows no loss of fertility.

(2) The cost of cultivation and weeding is decreased. Drained fields are easily kept free from weeds during the monsoon, and can be prepared for *rabi* crops much more quickly and cheaply than ordinary undrained land. In wet years this is a very great advantage as the

low-lying wet lands which are undrained can never be got ready in time for a full crop to be obtained.

(3) The fine soil or silt is retained on the land. At the present time in the alluvial plains of India large quantities of fine soil are every year carried away by rain-wash into the rivers and low-lying areas. This means great diminution of fertility as the loss of this fine soil lowers the water-holding capacity of the land. Further, the rivers tend to get silted up and their drainage capacity is lowered by the extra work of transporting the silt. Under the Pusa system of drainage the fine soil is largely retained on the fields. The grass borders stop the run off sufficiently to allow the water to deposit the silt before flowing over into the ditches. Slight slopes drained in this way in a short time become a series of terraces. Some measurements made at Pusa this cold weather will show the enormous value of the system in checking the loss of silt. Plot I in the northern trial ground is rectangular in shape and slopes from south to north and is 94 feet wide. It was drained in 1909. In January 1914, the northern edge had been raised 6·5 inches above the original level. This is a plot of light land and on such areas the loss of silt is greatest. Plot II of the pentagonal field is also rectangular in shape and slopes from north to south. It is 194 feet wide and was drained in 1909. In January 1914 the south edge was 4·5 inches above the original level. The soil in this field is moderately heavy and so the loss of silt is less than in the first case.

From the agricultural standpoint the great advantage of this drainage system is that it enables the cultivator to control the rainfall and to retain his soil. In wet years he can get rid of the extra water and in dry years the fields can be embanked and all the rainfall held on the land. That the system can be taken up on the large scale is shown by the following report, dated 3rd January 1914, received from the manager of the Dholi estate in Bihar:—

"During the past year I have applied the system of surface drainage to some 40 bighas and I intend to extend it to the whole of my factory *Zerats* here and at the outworks. The lands which I drained in this way this year were formerly, in a wet year, more or less water-logged, the whole of the rains owing to the water from the higher lands draining into them. This year I was able to cultivate and keep them clean all through the rains, and even after the late rains which we had this year, I was able to sow wheat in them before the end of October."

Any scheme of drainage will pay its way agriculturally and the anti-malarial benefits will, so to speak, be thrown in.

MAJOR C. H. BUCK said that he had been, for the last six years, in a district in the Punjab where silting had been done in a canal with the express object of reducing malaria. He then read to the Conference the following note in silting operations in the Western Jumna Canal.

"The Western Jumna Canal flows, from its head-works at Tajiwala as far as Indri, in an old bed of the Jumna skirting the old high bank. It formerly continued in that channel past Karnal, and made the place so unhealthy that in 1843 the troops were removed from there to Ambala. It was not until 1881—86, however, that steps were taken to remove the evil. The main branch of the canal was then realigned from Indri and carried along the high ground west of Karnal. This caused an immense improvement in the health of the villages below Indri.

In 1892 the Sirsa Branch was taken off from Indri and, in order to give it a supply, the banks of the canal in the old channel were raised and the water backed up by a regulator. Since then there has been much percolation above Indri and stagnant swamps have formed in all the villages skirting the canal. Spleen disease and malaria have prevailed there, and cultivation has also been injuriously affected except in seasons of drought.

In order to do away with these evils three methods were considered: first, the further re-alignment of the canal above Indri; secondly, the treatment of the bed with impervious matter; and lastly, the construction of silting reaches. The former was too expensive, the second was found impracticable, and silting was favoured.

In 1899 the first silting reach, about 3 miles long and a quarter mile wide, was opened on the right bank by Chhalaundi; this was closed in 1903 and the area thus reclaimed has since been regularly cultivated. Before this silting reach was opened the death-rate of the neighbouring villages was over 50 per thousand; since the reach was closed it has gone down to 40 and the population has been almost stationary.

In another group of villages situate on the left bank further down the canal, where there has been bad percolation and no silting, the decrease in population during 1901—1911 was 27 per cent.

In a third group situate one or two miles away from the canal the death-rate was 53 per thousand, but in 1910 a silting reach was opened between these villages and the canal, and during the years 1911, 1912 and 1913 the death-rate has been only 37. This group had lost 30 per cent. of their population in the ten years prior to the silting. Further silting reaches are now being started in this unhealthy tract.

The silting reach above Indri was opened in 1910 and closed finally in 1912. It is 3 miles long and 1,100 feet wide, or 400 acres in extent. The cost of making the embankment was about Rs. 60,000. The operations of opening and closing it, the acquisition of the land and other expenses, amounted to about Rs. 15,000. The total cost was thus Rs. 187-8-0 per acre.

The reach was kept open during the hot weather months April to October during the three years and carries the whole canal. It takes from 3 to 5 days to open and also to close the reach. It would be possible to so select the time for closing the reach towards the end of the third season, that the last layer of silt would be good soil.

My conclusions are:—

(1) that where there is percolation from a canal, spleen disease and malaria are prevalent among the people, and there is sickness among cattle;
(2) that excessive percolation makes the land unculturable;
(3) that where there is percolation and the canal cannot be suitably re-aligned, silting reaches should be constructed as these reclaim the swamps and render the tract healthy;
(4) that towards the end of the silting operations the floods should be watched in order to select a time for closing, and thus to secure a good top dressing. If this were done, the land reclaimed could be let for Rs. 5 per acre for the first five years, giving a return on expenditure of 3 per cent. and thereafter it would bring in over 5 per cent.

Particular care should be taken to lay the silt evenly, and the final layer should be of good soil at least one foot thick."

THE HON'BLE MR. RAMACHANDRA RAO PANTULU GARU said: I come from Madras, from that part of it which is very much irrigated, *viz.*, the districts of the Godavery and Kistna, where canals have been made without attendant drainage, and all that has been said to-day by Sir Edward Buck, Professor Howard and Major Buck confirms us as to the necessity for drainage maps. In the part of the country from which I come, irrigation systems have been constructed and the only drainage that has been made is for the protection of crops, and not at all for the drainage of the villages which are affected by these large projects.

A full description of the condition of such villages is given in my paper, and I need not refer to the subject in detail except for the purpose of insisting on the absolute necessity of drainage, and the

early compilation of drainage maps. All the diseases which are described as existing in the irrigated tracts of the Punjab are prevalent in Madras, and I think that if anything can be done to mitigate these evils the subject certainly deserves the best consideration of this Conference.

THE HON'BLE MR. C. H. HUTTON said:—I must admit that in the early days of canal construction but little attention was paid to the natural drainage, and channels of the kind described by Sir Edward Buck were taken right across the country without reference to drainage or anything else. But during the seventies the evil of obstructing drainage became very apparent. Not only must the obstruction of drainage be avoided, but owing to the placing of water upon the land it has also been found necessary to improve the surface drainage of the country, and many lakhs of rupees have been spent on the Ganges, the Lower Ganges and Jumna canal systems both in improving the natural drainage and in digging surface drains. It is now thoroughly recognised by all irrigation engineers, that irrigation and drainage must go hand in hand. Sir E. Buck has laid stress on the importance of drainage maps. This has been recognised in the Irrigation Branch of the United Provinces for many years past. In fact, I think it was due to Sir Edward Buck himself that these maps were first started by Colonel Clibbon.

Whenever any channel of any kind whatever, whether a canal or distributary, is projected, a large sheet tracing of the village maps is made (16 miles to the inch), on which not only is the levelling work placed, but the flow off of the drainage of the country is shown by arrows from actual inspection. When this is done properly there can be no doubt in what direction the channel should run in order to avoid obstruction.

With reference to my report and that of Sir Edward Buck on the utilisation of silt in Italy and in this country, I have put up a few notes on the works which have been undertaken on the canals in these provinces. I should very much like to point out that the conditions in these provinces are very different indeed from those in Italy. In order to carry out land reclamation by the process called *colmata*, three conditions are necessary, *viz.*, large areas to be dealt with; large volumes of heavily laden silt water which can easily be diverted to these areas; and a good command of levels to avoid handling the silt as much as possible.

The proportion of silt in the rivers (they are really torrents) which are dealt with in Italy is something enormous. I am not aware that any other rivers in any other part of the world carry the same amount of silt. The proportion in several of these rivers in connection with the works which I visited was 1 in 10, which is very high indeed. The average maximum proportion of silt in the Ganges is 1 in 800. I once in the Ganges found a proportion of 1 in 30 or 40, but that was during the Gohna flood, when a huge volume swept down the Alaknanda valley owing to the bursting of the Gohna Lake. If there were a high proportion of silt in our rivers the lives of our reservoirs would be very short indeed. The proportion in the Bandelkhand rivers may be taken as about 1 in 1,600 as a maximum. The figures for the Ganges and the Bandelkhand rivers are very different from the figures given by me in the case of the Italian torrents, and silting operations here are likely therefore to be very protracted. Another great advantage which obtains in Italy is the command of levels. In the silt traps along the banks of our canals we have almost invariably to handle a certain amount of silt, and this adds considerably to the cost. In Italy they are able to place the bed of the canal at its outlet into the silt trap at the level to which they desire to raise the land, so there is practically no handling of the silt whatever. Another advantage is that the silt in these Italian torrents is of a uniform specific gravity, it is mostly clay and deposits itself in a very uniform manner. This is not the case

with the Ganges or Jumna canal waters which contain a large amount of sand as well as clay and silt; the deposit is not uniform and we have to dig channels every now and then and handle the silt. I would also call attention to Appendix 5. This is an analysis of the silt which may be taken as typical of what we get into our silt traps. The remarkable thing about it is the small proportion of clay and fine silt, while sand, coarse and fine, amounts to 83%. This compares very unfavourably with the analysis of silt in the Italian rivers which is given in my report.

MR. ROBERTSON:—In Sikkim a system of terracing is in operation which bears some resemblance to that described by Mr. Hutton. When new land is being opened the trees are felled and rolled against the stumps so as to lie along the contours. Stumps not used for these supports are then pulled up and hauled into position to pack up spaces between the trees. The ploughing is then done horizontally, so that the soil gradually shifts down to form terraces, with the tree trunks, stumps and stones as supports. Water is at the same time diverted from the streams to irrigate the terraces and thus incidentally to bring mud on to them. Some bunding up of stream beds to form terraces is also done, but this does not seem to be a general practice. As a rule they are left pretty much as they were when covered with jungle.

RAI BAHADUR K. C. BOSE said that thanks were due to Sir Edward Buck and Mr. Hutton for their disinterested labours in the cause of the country. He thought the time had come when the scheme as outlined by Sir Edward Buck and Mr. Hutton might be experimented upon in their own provinces, but how far that would prove a success was a question yet to be determined. In the riparian districts, especially of his province, the experiment might, with advantage, be tried. There was an opportunity afforded by the breaches caused in the continuity of the embankment of the Damodar river; the disastrous floods in the Burdwan district might teach them a lesson, and out of evil good might come. He would explain the brief outline of the Damodar river. There were embankments on both sides of the river, but the western bank was removed to the extent of 22 miles. There were villages on both sides of the river, but the people in the villages on the side protected by the embankment suffered more from fever than those living on the other side of the river where there was no embankment. On that side silt was deposited with such marvellous rapidity that within 10 or 15 years it had risen more than 12 feet, and as a result of this deposit of silt more land had been used for residential purposes, and malarial fever had considerably decreased. Figures spoke better than a mere statement of facts, and he had a table of figures collected from the Sanitary Commissioner's Office which showed that in the Sudder Station of Burdwan on the side of the embankment the fever was much greater than in the part where there was no embankment.

MAJOR W. W. CLEMESHA:—I think that in connection with another paper on Vital Statistics by Dr. Bentley we shall be told that there is an area consisting of about one-third of the Province which coincides almost entirely with our maximum total death-rate and our maximum death-rate from malaria. The parts of Bengal which are flooded regularly by the rivers are virtually free from malaria, but there is no doubt that the area that is now passing from the zone of natural inundation is the one in which malaria is rife and is very suitable for a trial of the method suggested by Sir Edward Buck.

As regard the remarks of Mr. Hutton on the subject of silt, we have been making a very careful study of the silt that can be obtained from the rivers in the Gangetic area, particularly that brought down by the Brahmaputra and the Ganges, and my figures incidentally correspond very largely with those given by Mr. Hutton. I do not quite know whether Mr. Hutton's figures are by volume or by weight. Mine are by

weight, and we find that the maximum amount of silt we can ever hope for in the riverain part of Bengal is, roughly speaking, 250 parts to a hundred thousand by weight. We have got a large amount of detail in Bengal, mostly collected by myself and my officers, which could, I think, be of considerable value in showing the quantity of silt that could be obtained in an average year.

As regards the analysis of the silt, in our part of the world we get the fine silt which comes down from Northern India. Anyone who sails down the Ganges or any one of the large rivers can see at once the reasons for this. The rivers are extremely broad and there is very great variation in the current in different parts of the river. In parts of the river where the current is slow, the heavy silt precipitates very rapidly. The consequence is that the further the river proceeds the greater the proportion of fine silt there is. So that Bengal is really extremely favourably placed from this point of view. That is to say, that only in the very height of the floods do we get a large quantity of sandy material. The major portion of the silt that we find in our rivers is extraordinarily fine, as all know if they have anything to do with the filtration of water. The trouble of getting rid of this fine silt, as a preliminary arrangement for preparing drinking water, is extremely great.

In Bengal the silt we obtain is very fine, and has a tendency to set into a very firm and adhesive clay. The agriculturist will be able to tell us whether this is a desirable state of affairs from the point of view of agriculture and land generally; from an observation of the Province it appears to be an extremely good fertiliser. In the parts of the Province where this silt is deposited there is no famine; everybody is extremely well off, and the people can get magnificent crops on the same ground year after year with the minimum of agricultural labour. We have been trying this method of *bonificazione* in one place by making use of the Bhagirath water in a bhil near Berhampur. The object of that is to reclaim the land. It is a long straggling sort of depression which is no use to anybody at all, and from its nearness to a comparatively thriving town, is probably a source of a considerable amount of malaria and ill-health generally. The progress has been extremely satisfactory. We have raised the level of the bhil very considerably—the most favourable part of it about 2 feet, and the least favourable a matter of two inches. The work has, I believe, been an entire success from a malarial point of view. I should like to see an experiment on a very large scale tried in one of the many extremely suitable places which we could provide in the Province of Bengal, and I think it would not only be of benefit from the agricultural aspect of the question, but also from that of the health of the people.

MAJOR S. R. CHRISTOPHERS:—None of the papers to-day have dealt practically with the malarial side of the question. I have a few words to say from that point of view, leaving the engineering side alone. Even if silt deposition be thought of only as a means to increase the agricultural value of the land, it would still be a measure looked upon with favour by the malariologist because we now know that with increase of prosperity there is diminution of malaria. But for the present we want to look at it from a more direct point of view.

Three questions naturally present themselves. They are:—

(1) What do Italian malariologists, those who know the modern notions about malaria, think of the value of the method of *colmata?*

(2) Supposing that the general opinion in Italy is that silt deposition is an important anti-malarial work, are there any reasons why they should not be equally valuable in India? and

(3) Supposing it is valuable, to what particular conditions are you going to apply it?

With regard to the first, of course, there is a general opinion that this method is a very good one, and the fact that the Government of Italy, which has had much experience, is carrying on such work so extensively makes one conclude that it is certainly thought to be beneficial. There are also observations by malaria men, observations by Rossi, Guarnieri and others. Professor Celli has made a number of statements about this method.

On this map (shown to the Conference), I have marked the chief areas in Italy where *colmata* and associated works have been carried out. The Valles de Chiana operations seem to have been extremely successful and similarly the Tuscan Maremma. In regard to the Roman Campagna there are some very interesting remarks by Professor Celli. He is discussing the relative merits of the two methods, and regrets that this system—that of silt deposition—has not been adopted here.

I think on the whole one can say that *colmata* is considered to be a very beneficial measure and its chief drawbacks are the great length of time it takes, and the fact that there is some possibility that malaria may be actually increased whilst the operation is in progress.

With regard to the second question,—would such operations be equally beneficial in India? In the first place, the conditions in regard to rain are quite different. In Italy the rains, I understand, are during the cold weather; these operations are in progress, therefore, at a non-malarial time, and the Italians are very careful that there should be no water lying about during the summer when malaria may be spread. It may be that in Northern India the work would have to be carried out during the very period that is suitable to malaria, and that may be found to be an important modifying factor. Another important point is that as regards malaria Italy and India are under different zonal conditions. If one looks at the distribution of malaria in the world, there are three very markedly distinct zones which have very definite and important characters—20 degrees and 40 degrees of latitude are a good rough guide to the limits of these zones. An important character of malaria in the northern or temperate zone is that it is practically confined to sea-level. A few hundred feet above sea-level may suffice to do away with it and it is generally associated with rank swamps. Another feature of this zone is that malaria has practically disappeared from large portions of it. England is a noted instance, but all through Europe there has been a steady diminution in malaria.

The second zone is almost the antithesis of the first. In the first place, it occurs up to 5,000 or 6,000 feet. In the second place, it pays no attention to marshes. It is very often extremely bad in very dry places, and there is no known instance in which malaria has been abolished. The whole of the northern part of India comes well within the zone to which I have referred, so that one might well find that things which worked wonders in Italy might be not quite so good in India.

There is a third point also which might turn out to be still more important. In Italy the carrier of malaria is *A. maculipennis*, while in India there are a number of species but more especially *A. culicifacies*. Malcolm Watson, when he was dealing with low-lying land, found that mere drainage and cutting down of forests sufficed to banish malaria. That was because he was dealing with a species of carrier which could not stand that amount of interference with its habits. But when he came to hilly country he could make no impression at all because he was there dealing with another species, which could withstand his methods and which he could not affect at all. *A. maculipennis* is a species which seems to like very definite swampy conditions. On the other hand, *A. culicifacies* loves everything in connection with canals. In India there are certain species ready to make use of any particular condition they might find. *A. culicifacies* would undoubtedly be a species which would

come into great prominence if we once started having large quantities of standing water in connection with canals.

The third point is what conditions in India seem specially adapted to this method? First of all, with regard to the great plains of India, I gather from Mr. Hutton that the method is not suited to say the Punjab plains or the United Provinces, and it would be a very serious matter if that were so, because the great Indo-Gangetic plain supports nearly half the population of India and from the prevention of malaria point of view it is the most important. However, I gather from Major Clemesha that towards the east the method would be more suitable.

Another point which affects Southern India relates to the purpose to which reclaimed land would be put. It would appear that such land would be ear-marked for rice cultivation. One cannot imagine any such land which would not be wanted for rice cultivation. Then we should have to consider the question whether rice cultivation on an increased scale would be bad or good.

A portion of India which has been mooted as likely to benefit from silt deposition is the Terai; but Mr. Hutton says that his experience of a portion of the Terai was not favourable. As regards the Darjeeling Terai and the Duars Terai, I do not think that it would have any application there at all. The whole place is given over to tea gardens and I do not think it would benefit. The part of India that seems to me to call for this method of treatment is the sub-montane tracts, more especially in the north-west where the sub-montane areas come into the epidemic zone. If one takes, for instance, a district like Gujrat, one sees at once how similar in position it is to the Italian zone of reclamation. It is also in the great epidemic zone of India, and anything done in this area to diminish malaria must be highly advantageous. I have had some figures showing the enormous increase of death-rate in Gujrat which rises to nearly ten times the normal during malarial times. It would seem, therefore, that Gujrat, Sialkot, and other places like that, are eminently suitable for this method of malaria prevention.

Another point is the inadvisability of thinking too strictly of silt operations only. Silt operations go along with drainage, with embankments of rivers, etc., which come under the name of hydraulic improvement, and I think that in India too something of the same sort should be attempted.

Dr. Bentley :—At the last Malaria Conference I called attention to the fact that a connexion could be traced in certain areas in Bengal, between soil exhaustion and the gradual intensification of malaria. Investigation in certain areas which showed a steady and progressive loss in population, associated with a high degree of malarial infection, brought to light the fact that a great reduction in the fertility of the soil had occurred, apparently as a result of the cessation of silt-bearing inundations from the Ganges or its distributaries, and the effect had been to diminish the returns from the land, bring about increased mortality, stimulate migration, and reduce the cultivated area; and indirectly lead to an intensification of malaria.

During the past twelve months I have continued my observations and have succeeded in collecting a mass of data which appear to support the view:

(1) that in the deltaic areas of Bengal still subject to inundation by silt-bearing river water, malaria exists to so slight an extent as to be almost negligible;

(2) that deltaic areas which have been deprived of natural fertilizing inundations have become intensely malarious and unhealthy; and

(3) that measures on the lines of those suggested in Sir Edward Buck's paper, which proposes to utilize river silt for the fertilization of the soil and the mitigation of malaria,

offer the greatest hope of success in Bengal and appear to be specially applicable to this part of India.

Bengal is mostly a delta or rather it is made up of many deltas. But in the past the exact significance of this fact appears to have been overlooked by those who have sought to explain the occurrence of intense malaria in Lower Bengal, or have suggested measures for combating the disease by drainage, etc. In a delta the physical character of the country is essentially different from that of other parts. Take the rivers! In a delta a river no longer receives tributary streams, but gives off distributaries. The land instead of sloping gently towards the river, slopes away from it. The water instead of flowing off the land into the rivers, flows from the river over the surface of the country. And the river channels instead of being the natural drainage channels of the country resemble a net-work of high level canals, which every flood season, pour over the surface of the land a wealth-producing stream of silt-bearing water.

Now this is the condition of what may be termed a living delta. In delta tracts there often appears to be a condition of great prosperity, an exceedingly dense population, owing to the extraordinary fertility of the soil, and little or no malaria.

In India, so far as I am aware, all living deltas are wonderfully immune from malaria. The deltas of the Cauvery and Koleroon, the Kistna and Godavery in Madras, the Mahanadi in Orissa and East Bengal which forms the living deltas of the Ganges and Brahmaputra, are but slightly malarious. And Lower Egypt, as is well known, is singularly free from the disease. It would appear therefore that deltas are naturally free from malaria. But in the case of Bengal a great portion of the delta has become intensely malarious.

If we examine a map showing the distribution of malaria in Lower Bengal we find that there is an area of intense malaria east of the Bhagarathi extending over almost the whole of Jessore, Nadia, Murshidabad and covering portions of Faridpur, Khulna, and the 24-Parganas. And west of the Bhagarathi is another area of intense malaria extending over Burdwan, Hooghly and portions of Midnapore and Birbhum.

Now these areas of intense malaria correspond in a remarkable manner with the deltaic portions of the country which have been deprived of their yearly inundations of silt-bearing water, either because of natural changes, or as the result of an artificial embanking of the rivers. If we examine maps showing the density of the population in Lower Bengal, the areas where the population is increasing and those in which it is diminishing, we find that the greatest increase is to be observed where there is greatest density, that is in East Bengal. On the other hand, the areas which are steadily losing population are those that have been deprived of inundation, have a much lower mean density of population, and show great prevalence of malaria.

If we make a further comparison between conditions in the living delta areas of Eastern Bengal and those in the dead delta areas of Central and West Bengal, we find that whereas in the former, culturable waste and fallow land is equal to only 11 per cent. of the cropped area—in the Burdwan division and in Central Bengal areas equal to 39 and 40 per cent. of the cropped area are fallow and waste. And yet history shows that these latter areas which are becoming less and less fertile were at one time in the most prosperous condition. Bernier in his "Travels" speaking of Lower Bengal, says that the country was of unsurpassed fertility and deserved to be called the granary of the world, rather than Egypt. And Hamilton describing Burdwan district a hundred years ago, says that it was the Garden of Bengal, and that seven-eighths of the total area was under cultivation.

If we examine Rennell's map of 1789 which shows the inundated portion of Bengal at that time, it will be noticed that a very large part

of Jessore and Khulna and practically the whole of Faridpur district used to be annually inundated. But at the present time the northern portion of Faridpur is above flood level and only a small area of Jessore in Narail is subject to flooding.

In the dry areas of Jessore and Faridpur malaria is intense. In the flooded areas of Faridpur it is practically absent, for the spleen index is below 1%. In Narail there is less malaria than in any other part of Jessore. Where there is flood water there is greater fertility and greater density of population. In Faridpur district the areas which are regularly inundated from the Megna support an agricultural population twice as dense per acre as those which get no river floods. And this is the case with Eastern Bengal as a whole. In portions of the Dacca district the density of population is as high as 2,300 persons per square mile of cultivated area. The wealth of these inundated tracts is enormous. But for these annual floods the jute trade would soon be ruined, for the main supply of that product comes from areas annually enriched by silt.

Turning once more to Central and West Bengal, we may note that the greater portion of Nadia, Murshidabad, Hooghly and Burdwan have been deprived of the natural inundations to which they were once subject, by the construction of river embankments. In the old days, 50 or 60 years ago, these embankments were kept in such bad repair that they did not prevent flooding of the country, and their harmful effect was not apparent. But shortly after they were made really efficient barriers to the inundation, the protected areas began to suffer in various ways. The fertility of the soil has been diminished, population has declined, and malaria has increased to an appalling extent.

A study of the conditions appears to show that the only effective way of combating malaria in these areas is to encourage agriculture, and bring once more under regular cultivation the areas of waste and fallow which are no longer cropped. But to bring this about it is essential that the fertility of the soil should be restored and this can only be done either by the use of manures or the utilization of river silt.

That some such measure as flood or basin irrigation would achieve this result, appears likely, judging by the effect of the recent floods in the Burdwan district—where many areas have benefited by increased crops and lessened fever.

It might be remarked also that when in 1881 the Eden canals were opened as a sanitary measure mainly with a view to provide an improved supply of potable water, the villagers on the banks of the khals flushed by canal water, immediately began to use this water for irrigation purposes. This was not for lack of rain, for the Hooghly district has an average fall of 55 inches, but solely because the use of river water meant greatly increased crops.

At the present time the cry for river water is heard in every malarious portion of the delta of Bengal, but though the educated non-cultivating Bengali asks for water for potable purposes, the mass of the cultivators want to see silt-bearing river water flowing over their lands.

There are strong grounds for supposing that if we can find means for bringing the silt of our rivers once more upon the soil of the malarious areas in the delta, we shall attack malaria in three ways :—

(1) By reducing the breeding places of the anopheles ;
(2) By increasing the prosperity of the population ;
(3) By checking the loss of population in malarious areas.

As I have already stated, the delta tracts of Bengal offer special facilities for the carrying out of measures such as those suggested by Sir Edward Buck. Half the work has been done already. Many of the rivers have already been controlled by embankments, and it only remains to restore their wealth-producing floods to the land surfaces from which they have been barred. It may be said that the introduction of more water to areas which have often been described as "water-logged" is a

serious danger—and that by doing so we may increase malaria. But in the parts of which I speak malaria is already so intense that it is a difficult matter to conceive of its being made worse, and personally I think that this suggested use of river silt offers the only solution of the problem of rural malaria in Lower Bengal.

Dr. Bentley showed maps and diagrams illustrating his remarks.

Rai Bahadur Dr. U. N. Brahmachari pointed out that nature was carrying on the process of silting in some parts of Bengal with excellent results. Bikrampur in East Bengal includes a number of villages. It is much more free from malaria than other parts of Bengal and it appears that this is due to its being under water for some months of the year, during which the place is highly silted. There thus appears no doubt that the process of siltage recommended by Sir Edward Buck and adopted by the Italians should be introduced into India, and specially into Bengal with a view to the mitigation of malaria.

Mr. Godbole pointed out that the methods advocated for Bengal are not applicable to Western India, and gave an instance of how land had been made less productive after submersion. In some parts of the Bombay Presidency small field embankments might be thrown across small *nallas*, and silt collected in that manner might be useful for the land. There were some seaside places also where reclamation works will be feasible and will be profitable if carried out by the silt methods advocated. He thought that the small works which would be practicable in the Bombay Presidency would be more in the interests of agriculture than of prevention of malaria.

The Hon'ble Surgeon-General Sir Pardey Lukis :—Major Christophers has alluded to the work done by Malcolm Watson in the Malay States. In this connection I should like to mention that on the 21st November last Malcolm Watson read before the Society of Tropical Medicine and Hygiene a very interesting paper in which he detailed his experience in Panama, British Guiana, Sumatra and Barbadoes, and he concluded this paper by expressing his opinion that the eradication of malaria, even in rural districts, was not likely to be nearly as impossible as was generally supposed; but that if we would be successful in the attempt to accomplish this, it was necessary that we should approach the question with open minds and that we should be willing to consider any and every method which promised to give good results. He believes that the prevention of malaria is linked up in the closest possible manner with agriculture, and he holds that in the future irrigation, no less than drainage, will be one of the most important weapons at our disposal for breaking that vicious circle which makes the poor malarious, and the malarious poor. Finally, he urges that in all countries in the world, careful malaria surveys should be carried out on the same lines as those which are now being made in India, and that before large sums of money are expended on agriculture in the name of malaria, medical officers should be able to give substantial reasons for believing that the expenditure would be beneficial from that point of view. I think the remarks which have fallen both from Major Christophers and Dr. Bentley show how important it is that this matter should receive very careful consideration, and for that reason I shall have great pleasure in putting before the Scientific Advisory Board the proposal of Sir Edward Buck, that a medical mission should go to Italy to study the subject there, as well as considering the possibility out here. There is only one addition I should like to make to Sir Edward Buck's suggestion, and that is that the medical mission should not consist merely of medical men, but that it should also include a sanitary engineer.

Sir Edward Buck in replying said :—I wish to make a very few remarks in connection with some points that have been brought forward by the members of the Conference. First in regard to the remarks made by Mr. Hutton regarding the survey in connection with canals,

that the system recommended is adopted now in connection with new canals and distributaries from canals; in recommending drainage maps I was thinking of those provinces which are not so fortunate in possessing many canals. Attention has to-day been confined a little too much to the work of silt deposit in connection with canals. When I suggested a drainage map I was thinking, in regard to this Province, of much larger areas in which there are no canals. Take for instance the Province of Oudh which is almost devoid of canals. A year or two ago I visited the district of Bahraich and there I had an opportunity of learning a great deal about the largest estate in that part of Oudh, the estate of the Maharaja of Kapurthala. The Manager Mr. Wood told me on one occasion that there had been in the preceding rains an accidental diversion of a small river which had thrown, in the first fall of rain when there was plenty of soil in the river, a quantity of silt on the land, and that all neighbouring villagers came to him holding up their hands and clamouring for a bit of it. Those are cases to which I should like to see the attention of the engineers brought, and not merely to the country supplied with canals from the Ganges and Jumna and other large rivers. I should like to see the country in which there are no canals, but in which there are small rivers, examined. Surely if the great rivers like the Indus and Jumna can be controlled, these little rivers can be harnessed by our engineers, and it is for that purpose I should like to see these maps compiled. With reference to what has fallen from Major Christophers and Dr. Bentley, it is very gratifying to see that such expert attention is being paid to the whole subject, and it cannot but be that the investigations now launched by these scientific experts will lead to such measures as are possible in India. Of course, as Major Christophers pointed out, there are conditions in certain parts which make it impossible to follow the example of Italy, but from other statements that he himself has made, and from what has fallen from Dr. Bentley, there seem to be great hopes of mitigating malaria very largely by the raising of the land, combined, of course, as in Italy, with drainage. I will not detain you longer and will only state again my statisfaction at knowing that these important questions are in such able hands.

The Conference then adjourned and re-assembled in two sections for the consideration of papers on:

A—(*a*) Rural sanitation;
(*b*) The medical inspection of schools and the teaching of hygiene.
B.—Conservancy.

SECTION A.

(*a*) *Rural Sanitation.*

The Hon'ble Rao Bahadur Ramachandra Rao Pantulu Garu introduced his paper * on "Drainage and Sanitation in the rural areas in Madras Presidency," of which the following is a summary:—

It is necessary to determine the extent to which the activities of other departments of Government have contributed to the creation of sanitary evils in rural areas. In a consideration of causes and remedies a great deal of inter-departmental co-ordination is necessary in the cause of sanitary progress.

In the Madras Presidency the general sanitary condition of a district depends very much on whether it is grown with wet or dry crops and upon the rainfall. The problem of rural sanitation has become most acute in the tracts irrigated under the great anicut and river systems. Many of the villages are flooded, wet cultivation exists up to the edge of the inhabited site, cattle have to be stalled in the streets, the village sites are cramped and communications are bad. Without

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improving the general system of the drainage of the country where the village site is almost on a level with the cultivated fields, it is impossible to improve the sanitation of these areas. That the drainage of these large irrigation systems is defective has been admitted by the Government more than once. In Municipalities where water-supply has been introduced without proper drainage, loud complaints are heard, and a demand has arisen for the simultaneous introduction of water-supply and drainage schemes. In the case of large irrigation systems, some of which have grown upon the old existing systems of irrigation, the question of sanitation and drainage in the area has unfortunately been treated as of secondary importance. Irrigation Engineers and Revenue Officers in their desire to develop irrigation and increase revenues have overlooked the health and comfort of the people.

The improvement of rural sanitation depends largely upon the policy of Government in regard to the expenditure of money in the drainage of the major systems of irrigation.

The chief evils in rural areas requiring attention are :—

(1) Want of room in villages for houses.
(2) Want of room for cattle.
(3) Want of room for disposal of sweepings and rubbish.
(4) The absence of a good system of water-supply.
(5) Assignment of lands in close proximity to villages.

Congestion is due to want of method in the past in the grant of village sites, and to a great increase of population due to the extension of cultivation. The orders of the Revenue Board and the Government in regard to the extension of village sites have not been generally carried out.

The presence of a large number of cattle in villages is one of the features of rural life, and it is impossible to keep the village site clean and in a sanitary condition unless provision is made for standing ground outside villages for the cattle. The whole country round each village, up to the very doors of the houses, has been assigned on *patta* for wet cultivation, with the result that such of the cattle as are kept at home are practically confined to the inhabited village for nearly 6 months in the year. Some action is urgently needed to secure a belt of dry land round each village.

Tank and channel bunds are now greatly used for purposes of nature. The provision of latrines of an approved pattern in villages is not necessary and their supervision is not feasible. Topes and open spaces should be provided with shrubs and trees for affording cover.

The ultimate solution of water-supplies is in tapping underground supplies, and, as in America, the systematic survey of underground waters should be undertaken. Railway Companies should not be permitted to dig borrow pits in or near villages. Definite rules should be made prohibiting such evils. Present legislation is not sufficient.

The first and the foremost obstacle to rural sanitation is the lack of funds. Local Boards have not the funds necessary to remedy existing defects, nor should they bear the cost of sanitary reforms, as, for instance, drainage, due to irrigation projects. In the preparation of a scheme of irrigation, due provision should be made for expenditure on sanitation and communications of the villages in the tract of country affected by the project. Where villages are prejudicially affected from a sanitary point of view by the introduction of wet cultivation where none existed before, such expenditure as is necessary to counteract any evil effects should be debited to the irrigation project. This has never been done hitherto. In each province a Chief Engineer for sanitation should be deputed to safeguard sanitary interests. The present practice is that all sanitary works, the construction of roads, and the provision for extension of dwelling sites ordinarily devolve on Local Boards. This is neither just nor fair to the inhabitants of the affected area, or to the local authorities.

The question of organization is very important in securing sanitary progress. Some kind of village organization is necessary to carry out sanitary regulations, as official agency can do very little in the matter.

In introducing the paper the author said that what had been stated by Sir Edward Buck and Mr. Hutton cleared the way for the remarks summarised in his paper. The description given by him of conditions in Madras applied more or less to other provinces also, and delegates of other provinces would no doubt be able to tell the Conference whether the state of things in their provinces was exactly the same. He would invite particular attention to paragraph 6 of his paper where, after a detailed inspection of certain villages, the Sanitary Commissioner of Madras summarises the position. One of the suggestions he wished to offer was that all large irrigation projects should be subjected to a close scrutiny from the sanitary point of view, in order to make due provision for the evils which had arisen in the delta villages described in paragraph 6. The second point to which he would invite attention was the question of finance. He thought that a portion of the revenues raised in the deltas should be surrendered to the district boards for the purpose of sanitary improvements. As a revenue of 21 or 22 per cent. on the capital outlay is raised in the irrigated areas at the cost of the inhabitants, some consideration ought to be shown to their health and comfort. One way of financing sanitary projects in these large deltas would be by partly utilising revenues which had been raised in these deltas, and this would be a legitimate charge. He would like this question considered in all its aspects with reference to the question of financing sanitary improvements in these large deltas. He would only say with regard to organization that in the two other papers on this subject before the Conference the authors agreed with him as regards the necessity for some kind of village organization for sanitary purposes.

THE HON'BLE RAI SRI RAM BAHADUR introduced his paper on "Rural Sanitation in the United Provinces of Agra and Oudh," * of which the following is a summary :—

The proportion of the rural to the urban population in the United Provinces is as 9 to 1, and whereas measures for improvement are being undertaken in urban areas, very little is being done for the agricultural and rural classes. The latter, virtually the nation, contribute largely to the revenue, but are not in a position to voice their requirements. Meanwhile the 1911 census of the United Provinces shows a decrease in population of 510,233 as compared with the census of 1901.

An earnest appeal is made for more attention to, and the provision of larger grants for, improvements of rural sanitation. The first requirement is the provision of masonry wells where such do not exist, for drinking water. The author estimates this number at 47,180 and the cost at Rs. 1,65,13,000. This sum spread over a period of ten years would require an annual charge of 16½ lakhs, to which the Central Government should contribute half, and the District fund one-quarter, and the villages themselves the remaining quarter.

Measures should also be taken to protect wells from pollution and contamination, and for the periodical examination and purification of the water.

Other improvements suggested are the filling up of hollows, stagnant pools, and the removal of jungle close to villages.

Travelling dispensaries should be increased in number.

The author discusses the appointment of assistant health officers, their staffs, the co-operation of official and non-official agencies, *panchayats*, and gives in outline the probable cost of his schemes.

He said : "The scope of my paper is confined to rural sanitation in the United Provinces. In my paper I have sketched the condition of

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health in these provinces. The high mortality which is evidenced from the statistics given in the Sanitary Commissioner's reports for the last 5 years, together with the fact that the last census of the United Provinces (also that of the Punjab) shows a decrease of population instead of an increase as in other provinces of India, establishes the importance of the question. The question of rural sanitation has received the attention of Government now and then, but as the President himself has indicated in his opening speech to-day, the non-recurring grant for urban sanitation was 150 lakhs in the current year, for sanitation in the rural areas there was no grant of this nature. So far as these provinces are concerned, a non-recurring grant of 27½ lakhs and a recurring one of 6 lakhs were made, and it was stated that out of the latter the Local Government would assign an appropriate sum for rural sanitation. Enquiries which I have made have elicited the information that as regards expenditure on rural sanitation, the sum which appears to have been allotted by the Sanitary Board in the present year is Rs. 50,000, mainly for the improvement of wells, and to this sum another Rs. 50,000 is being added. Altogether these allotments amount to 1 lakh of rupees, and this is for a population of more than 42 millions. The first of the wants is the supply of pure drinking water. With a view to draw the attention of Government to this point, I have suggested a scheme for the improvement of water-supply in villages. According to the rough calculation which I have made, the total cost would amount to about 165 lakhs, which, spread over a period of ten years, gives an annual expenditure of nearly 16½ lakhs. I have suggested that one-quarter of this amount should come from the district fund, another quarter from the proprietors or other persons owning or occupying houses in the villages, and the remaining half from the annual subventions to be made by the Imperial Government. I have mentioned two other things which we want, these are the filling up of pits, hollows, etc., and cleaning the village site, and the appointment of a staff set apart for looking after rural sanitation. The latter would cost about 3 lakhs a year, and, taking 1 lakh more for other expenses, we have a total of 4 lakhs a year. According to the recent policy of the Government of India, the rates and cesses of these provinces have been relieved to the amount of 32 lakhs of rupees a year on account of the charges for rural police being taken up by the Government. If one-quarter or one-third of this amount be given for the improvement of rural sanitation, *i.e.*, for preserving and improving the health of more than 42 millions of souls who reside in the rural areas of these provinces and who pay the largest amount of Government revenue and the cesses, I submit that this will not be too large a sum to be spent for the purpose. In my paper I simply make suggestions which, though not those of an expert, are, at any rate, those of a man who has some personal knowledge and experience of these provinces."

THE HON'BLE MR. K. R. GODBOLE then introduced his paper on "Village Sanitation,"* in the course of which the author specifies the points that require immediate attention as regards village sanitation, and states that drinking water-supplies are being attended to, but that measures must be taken to clear prickly pear and noxious vegetation from village sites and their surroundings, and to arrange for the surface drainage of those areas.

He gives estimates of cost and explains how the scheme should be carried out—by what agency and from what funds.

Certain proposals are made regarding the agency which should look after the upkeep of the sanitary condition of villages when it is once put in order.

In connection with the question of latrine accommodation for villages, he suggested the conversion of night-soil into poudrette in the

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case of irrigation villages when there is a demand for manure, and suggests that the poudrette scheme may prove self-supporting.

The cost of the annual upkeep is estimated, and the sources from which upkeep funds should be forthcoming are indicated. A certain proportion of the local funds contributed by a village should be expended on the sanitation of the village itself.

In introducing the paper Mr. Godbole brought out prominently three points which, he hoped, would receive immediate attention; the necessity of providing wholesome drinking water; the securing of clean surroundings to ensure an uncontaminated atmosphere; and surface drainage. He had pointed out in his paper that as regards water-supply, sufficient measures were being taken at present by local boards from their own funds, and from the contributions they receive from time to time from the Provincial and Imperial Governments. As regards clean surroundings, he had suggested that all noxious vegetation and prickly-pear growth should be removed from within about 100 feet of all village sites and from the village sites themselves. As regards surface drainage, the pits and small depressions that abound in villages and their immediate surroundings, and in which stagnant water accumulates, should be filled up.

He had also suggested, in his paper, that the funds for carrying out the works should be drawn from the local funds, and funds raised under Acts like the Bombay Village Sanitation Act of 1889, supplemented largely by liberal grants from the provisions in Provincial and Imperial budgets for grants in aid to local bodies for sanitary projects.

In Bombay they were trying the experiment in two selected irrigation villages, of converting the night-soil into poudrette and selling the poudrette as manure. He thought this scheme ought to prove self-supporting and he would ask the Conference to suggest that similar experiments should be tried in other provinces.

As regards the upkeep of the sanitary condition of the villages, after the sanitary improvements were once carried out, he thought that the nucleus of such an upkeep fund should come from the local funds contributed by the villagers. When villagers subscribed to the local funds, some of their money ought to be spent on the sanitary upkeep of their own village instead of the whole of it being spent elsewhere, as was often the case at present.

As regards the agency of upkeep, he thought this should be the village *panchayat* or the taluk local board. In the case of small villages, he thought that a group of 7 or 8 adjoining villages should be taken together and worked on a common pooled fund, administered by the local board or a joint village *panchayat*.

Dr. C. A. Bentley: I was interested in Mr. Ramachandra Rao's references to the Godavery delta. He made some reference to the occurrence of severe fevers there. I should like to ask, is it a fact that there is really severe fever in it and that it is malaria? As far as I can learn, the deltas in India, the living deltas, are practically non-malarious, and it would be rather a striking thing, I think, if the irrigated tract of the Godavery delta was an exception to the rule.

As regards the suggestion with regard to drainage in these parts, I do not quite see how it would be possible to drain efficiently a place which is under water for a certain time of year. You certainly cannot avoid the fact that places will be flooded in these living deltas, and no drainage system will alter it, and it is also possible you will do a great deal more harm by attempting to remove the water. Probably the very fact that you have got a rapidly increasing population there, more rapidly increasing than in other parts of the Presidency, is due to the fact that you have got an excess of water. I shall be glad to have information in regard to the question whether it is a fact that these areas, as shown by mortality figures, are worse than drier areas in the Presidency.

The Hon'ble Rao Bahadur Ramachandra Rao in replying said that with reference to Dr. Bentley's enquiry, his impression was the

fevers in the Godavery delta were not malarious. He spoke subject to correction, but he rather thought they were regarded as some kind of malignant fever due to the prevailing dampness for almost 6 months of the year.

In regard to the question of the drainage of the deltas, his complaint was that no sufficient drains had been provided for the whole of the system. The description given by the Sanitary Commissioner, to which he had invited the attention of the Conference in his paper, conclusively showed that the state of things was so deplorable that it was certainly not at all beyond rectification. Their complaint was that the irrigation engineers had designed the system in such a faulty way at first, not with reference to the engineering questions, but from the point of view of sanitation, and that many improvements were necessary in order to eradicate the sanitary evils which had come about. It had been stated by the Sanitary Commissioner of Madras that rheumatism, respiratory diseases, bowel complaints, due to the insanitary conditions in which the people lived, were the principal causes of deaths among them.

As regards the papers read by the Hon'ble Rai Sri Ram and the Hon'ble Mr. Godbole, he was afraid he could not associate himself with what they said in regard to appropriation from local funds. In Madras they were hardly able to pay their way in the district boards. They should either be exempted from the duties laid upon them just at present, or they should be given more resources. He trusted that the Conference would press on the attention of the Government of India, through its President, the necessity of their giving them more money than they had at present. Any amount of discussion of sanitary proposals would be infructuous unless they were provided with better resources, and that was their great crying want at present. He appealed to the Conference to adopt a resolution that special attention should be paid to sanitation in the irrigated tracts. He had summarised his proposals on the last page of his paper and trusted that the Conference would be able to draw the attention of the various Local Governments to the improvement of the state of things revealed in the Madras Presidency, which he believed existed in the other Provinces as well, and he asked that the President might be pleased to examine this question from the point of view of the matters mentioned in his paper.

MAJOR JUSTICE said that an examination by Captain Horne of the vital statistics of ten years of the Presidency did not reveal any marked rise in mortality due to fevers in the Krishna delta, though the portion of the river, before it reached the delta, was notoriously malarious.

DR. SOUZA said that the question of a water-supply in a village is of prime importance. In the United Provinces the population of villages consists of various castes. Any one whose duties take him to a village will have noticed the number of wells there are, and that each caste or section has its own well or wells. Generally there are more wells than one for each section. There are castes which have no objection to drinking out of a common well. The first duty of Government is to ascertain how many wells are absolutely essential, and this can be found out in the village itself. These wells should then be constructed on sanitary lines and maintained in good order and allotted to the necessary sections.

Sites for latrines and rubbish dumping-grounds should be selected a little away from the village and on the side towards which its drainage runs. The latrines should be of trench pattern.

The cultivators reserve their own rubbish for manuring their fields and they each prefer their own dumping-ground. This can be solved by having a sufficient number of pits in the selected sites and allotting them to the cultivators.

No cultivation should be allowed within 50 feet of the habitations.

Sweepers should be appointed on the population basis, *i.e.*, one sweeper for every 200—1,000 population.

The village chaukidar should be held responsible that only sites selected for latrines and rubbish disposal are used, and that the sweeper covers the filth and rubbish properly.

Annually after the rains there should be a general clearing of the village when all rank vegetation should be removed, tumbled down houses levelled to the ground, drains repaired and hollows filled up. In municipal villages the Health Officer and his inspectors should supervise the work of the chaukidar, and in the district, the District Sanitary Officer with his vaccinators and other staff.

(*b*) Medical Inspection of Schools and the Teaching of Hygiene.

Rao Sahib G. N. Sahasrabudhe introduced his paper on "The medical inspection of schools and school hygiene,"* of which the following is a summary :—

After emphasising the importance of health and sanitation, the present sanitary condition of village schools and the physique of school children is described, and the effect of the tendency to "cramming" noted. Reference is made to the progress made in England and America in connection with the medical inspection of schools and school hygiene, and also to the International Congress held in London in 1907. Difficulties experienced in America are described and suggestions made as to method and scope of the work in this country. The importance of the education of both teachers and scholars in hygiene is emphasised. It is suggested that Government should build some schools on model hygienic principles.

The author said that the subject of the medical inspection of schools was such an important and interesting one that he did not think there would be any difference of opinion amongst the members of this Conference regarding it. Its importance was admitted on all hands, and at the International Conference in London presided over by Lord Crewe. The Government of India had accepted the proposition that the system of medical inspection of schools was in force in this country, but in his humble opinion it seemed to be of a rather cursory nature. Medical inspection must be of a very thorough nature. Great progress had been made in medical science, and it was now in the power of human beings to detect the causes of diseases at the beginning. The present cursory examination of school children was not sufficient to help the children who were being in fact educated at very high pressure, and crammed with too many subjects, which injure, if they do not overpower, their power of mental digestion. In connection with this subject two points must be considered by the Conference :—(1) the practicability of the introduction of this system, and (2) the question of finances. As to practicability, there existed a mass of prejudice among the people who might be hostile at the beginning, but he thought this hostility would subside as soon as the people saw the good sense and the advantages of inspection. Connected with this was the ignorance of the people. It was admitted that the ignorance of the people always came in the way of progress. It was hardly fair to blame the ignorant man ; he required to be educated, and he admitted the Government of India was doing its best to further the cause of primary education, and was spending large sums of money on it. He thought a measure which was proposed some years ago by his friend the Hon'ble Mr. Gokhale in his Elementary Education Bill would have been a good help to the cause of education, and he was sorry that it was not approved by the Government of India. He thought it should be re-introduced in the Imperial Legislative Council, and he hoped that it would obtain the sanction of H. E. the Viceroy, who was a very sagacious and far-sighted statesman.

He added that his sole object in bringing this paper forward was to help the poor school children and enable them to enjoy the blessings

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of school hygiene along with the other numerous blessings which they enjoyed under the British Government.

LIEUT. DR. FROILANO DE MELLO said :- -Le monsieur dit à page 4 que dans le cas de maladie infectieuse, le médecin fera un rapport au Head Master qui prendra des mesures convenables. Je n'accepte pas cette façon de voir, parce que seul le médecin a de la compétence pour ordonner des mesures prophilactiques. et c'est un fait qu'il y a malheureusment et toujours opposition entre les autorités medicales et administratives. Je veux donc que le médecin ait toute son indépendence pour agir dan les cas de maladies contagieuses selon sa science et conscience lui ordonnent.

MAJOR HARRISS : I would like to call your attention to the action taken in the United Provinces with regard to school hygiene. A committee met in Naini Tal in July 1913, and discussed the subject of school hygiene under the following heads :—

(1) Hygienic requirements of schools and college buildings.
(2) Hygienic requirements of hostels.
(3) The sanitary inspection of buildings, Government and aided, and medical inspection of scholars.
(4) Quininization of scholars.
(5) The effect of the curricula on the health of the scholars.
(6) The teaching of hygiene.
(7) Personal hygiene.
(8) European schools.
(9) Factory schools.

The hygienic requirements of schools and colleges were discussed under the following sub-heads :—

(1) Choice of site ; (2) Drainage ; (3) Lighting ; (4) Ventilation ; (5) Type of building ; (6) Orientation ; (7) Cubic and superficial space ; (8) Furniture and equipment ; (9) Seating accommodation ; (10) Water-supply ; (11) Latrine and urinal accommodation ; (12) Play ground ; (13) Menial staff.

For the sanitary inspection of buildings and the medical inspection of scholars, the proposals of the Committee were that District Sanitary officers should be appointed who would, in addition to their duties in connection with rural sanitation, the sanitation of Act XX Towns and Notified Areas and with epidemic diseases, carry out the work of a school medical officer of health and should submit reports on the

(1) Site ; (2) Drainage ; (3) Lighting and ventilation ; (4) Type of building and orientation ; (5) Cubic and superficial area ; (6) Furniture and equipment ; (7) Water-supply ; (8) Latrine and urinal accommodation ; (9) Playgrounds ; (10) Menial staff ; (11) Hospital accommodation ; (12) Cook-houses.

The Committee recommended that there should be in the custody of the Headmasters a medical history sheet for each scholar which should provide for three inspections. The duties of these medical officers of school hygiene would not in any way clash with those of the medical officer of the school. In European schools, and in colleges, the Civil Surgeon or other qualified medical practitioner would be in entire medical and sanitary charge of the school and would submit yearly reports on the health of the scholars and on the sanitation of the schools in their charge. In municipalities by which health officers are appointed, the schools within the municipal areas would be inspected by the health officer. Deputy Sanitary Commissioners would also report on all schools.

It is in rural tracts that the medical officer of school hygiene will experience difficulty in getting his recommendations carried out. His work for the present will be limited to the prevention of the spread of contagious and infectious diseases, including conjunctivitis, scabies, etc.

One copy of the orders he may issue will be handed to the schoolmaster, another will be sent to the Inspector of Schools of the Circle. The schoolmaster will send a copy of recommendation for the treatment of the case to the nearest travelling dispensary or dispensary. The Inspector of Schools will make careful enquiry into the action taken.

The next point of importance was the question of the teaching of hygiene in schools. The Committee suggested that an officer holding qualifications in hygiene should give every alternate year lectures in malaria, and biennial lectures in hygiene. The teaching must be practical and should include elementary physiology, water, air, food, with reference to their purity and source, personal hygiene, ventilation and sanitation of houses, and facts regarding the chief infectious diseases, their etiology and prevention, both personal and public. For schools, the Committee were of opinion that hygiene could not be introduced as a separate subject in the Matriculation or school leaving certificate examination, as the School, University and Educational Department would probably object to its introduction; while for a vernacular final examination it is impossible at present to arrange for teaching up to a standard which would justify its inclusion as a compulsory subject. In all but the highest classes, that is in all classes except IX and X in Anglo-vernacular schools, and V and VI in vernacular schools, it is considered better that lessons on the various points be introduced into the readers, replacing if necessary matter already therein, than that a specific text-book be used. If only one text-book be used, selected chapters being studied in each class, the pupils would probably leave school remembering only the last lessons taught them, while those who do not complete the school course would not have that knowledge of the general broad outlines of the main principles of hygiene, which it is intended should be taught in the early stages and amplified in the later ones. If separate text-books are used for each class, the subject then becomes of too high a standard, and incidentally adds to the weight of the curriculum, and to the possibilities of overwork on the part of the scholars, which the course as proposed avoids; while if one small text-book be used in the highest classes only, it would, in all probability, be crammed up just before the examination and be therefore of less than no value. The lessons should in all cases be illustrated and amplified by the teachers with the aid of object-lessons, as far as practicable, from every-day experience. They should be drawn up by the Sanitary Department and revised by the Educational Department to ensure the language and construction used being suitable. The requisite course of lessons in elementary hygiene could be incorporated in about forty lessons, of which five might be included in the readers for class III, six in each of those for classes IV and V, seven in that for class VI, and eight each in those for classes VII and VIII.

Mr. G. E. Fawcus :—We in Bihar and Orissa too have had a Conference on school hygiene, and though the recommendations of the Conference have not yet been published, I think that they agree to a very large extent with what we have just heard of the recommendations of the United Provinces Conference. In the papers now before us attention is drawn to the over-work of the children in schools, but I see that it is also suggested in those papers that an additional subject, hygiene, should be added. It seems to me that in this respect it will be necessary for all provinces to follow the recommendations of the United Provinces Conference, and to substitute instruction in hygiene for something already in the syallabus, not to add an extra subject. The course should be an exceedingly short one. The improved methods of teaching which it is hoped to introduce in this country in the near future will give harder work to the boys. Cramming, I venture to think, causes less mental exertion than working on a rational method. The latter will cause greater mental strain, and I would suggest that the Conference should look at the matter from this point of view and see whether it is not necessary to lay down some limit to the number of hours of study in schools, so

as to counteract the effect of the greater intensity of study which rational methods of teaching will introduce.

There is another point to which I should like to draw attention. In one of these papers it is stated that you cannot have physical training without medical examination. It seems to me that it is not necessary to wait for medical examination before you have physical training. At the great schools in England, there is plenty of games and physical training and in very few has medical inspection got far except in County Council Schools or what are called in India "public schools." I would suggest that physical training might be pushed on much more rapidly, *i.e.*, that the provision of playgrounds and gymnasia and things of that kind might be pushed on much more rapidly than medical inspection, which will have to go very slowly for fear of raising prejudice.

In connection with buildings two points are mentioned in these papers. It is suggested that all plans for buildings and sites should be examined by the medical authorities. I would very much deprecate any suggestion that the medical department (the Civil Surgeon of the district, I presume, is intended,) should be the only authority which decides whether a plan is properly adapted for a school building. It seems to me that this is a technical matter which should form a subject of instruction in training colleges. Inspectors should be carefully trained in the requirements of schools in regard to light and such points. These are points which it does not take long to learn, but which one does not notice if one has not been specially trained for the purpose.

There is, lastly, a point of great importance in regard to buildings to which I should like to draw the attention of the Conference. The Government of India have made very large grants for primary school buildings—our own Province has received 10½ lakhs for that purpose—and I would like to suggest that we should point out the desirability of spending the great majority of that sum on schools in towns. One of these papers brings out well the very bad condition of school houses in towns, the absolute lack of ventilation and air. These are things that can be got much more easily in villages. It might be well to emphasise the necessity for acquiring land for playgrounds in towns and for spending on schools in towns and congested areas a very large portion of the funds which, we are glad to see, are already available.

THE HON'BLE MR. RAMACHANDRA RAO said he would like to say one word with reference to what fell from the last speaker on the subject of school hygiene. He believed the gentleman who introduced the paper said nothing as to who was to pay for it. He did not know what was the state of things in the United Provinces. They were all anxious to do as much as they could from District Boards and Municipalities, but they found it very hard to find funds for this purpose. In Madras a committee had been appointed and was now sitting with reference to this matter. But the great point was as to under whose authority this inspection was to be made and from what resources the money was to be made available.

In regard to what had been said in reference to school houses in towns, he thought it would be a good idea to make a beginning in municipalities with school inspection. The schools were much more concentrated in towns and it was quite possible, provided the funds were forthcoming, to arrange for medical inspection.

As to school buildings, thanks to the generous grants made by the Government of India, they were now able in Madras to construct elementary school buildings on a large scale. So far as the plans were concerned, a point had been made that they should not be approved by medical authority. In Madras some of the plans had been partly standardised, so far as school buildings went, but some discretion had been allowed to local authorities to alter the plans to suit local requirements. They had found the plans prepared by the P. W. D. very costly in Madras.

THE HON'BLE MR. GODBOLE said, with reference to remarks made by

a previous speaker regarding spending additional funds in the erection of schools, that he wished to press on the Conference the urgency of providing school houses for villages. In the district from which he came there were certain schools which were located in village dharmsalas and temples, and when there was a local fair the school was turned out for two or three days and teaching stopped, because the temple had to be used for its legitimate purposes. He thought, therefore, the first claim on any available money for school buildings should be that of village schools and such schools as were located at present in dharmsalas and temples.

RAI BAHADUR GUNGA PRASAD VARMA said that the question of model schools was fully discussed by the hygiene committee who desired to have a school which would cost something like 6,000 rupees. But it was found possible by the Primary Education Committee to pass plans for a model school costing 2,000 to 2,500 rupees. It was necessary to have soild buildings in villages and these buildings should be ventilated. *Katcha* buildings cost too much in repairs and did not last more than 10 years, and every year they cost 300 rupees in repairs, white-washing, etc., while a *pucca* building would last 25 or 30 years without any repairs.

RAO SAHIB G. N. SAHASRABUDHE : In regard to the question of cost, he had already said that municipal committees and district boards ought to bear the burden,as it was their duty to keep the children in good health, and this fund should be supplemented by Government. The other questions of how the school should be built, etc., were matters of detail which could best be determined by a sub-committee appointed for the purpose.

DR. SOUZA :—I think we are agreed that medical inspection of children is desirable, but at the same time we cannot put the cart before the horse. Most of us, especially health officers, have noticed the disgraceful condition of the majority of municipal and village schools. These have been constructed and located without any regard to the elementary principles of sanitation. Our first duty is to improve the schools before we start on any medical inspection of children. The school should be built on an open site and constructed on sanitary lines. We know that Municipalities and District Boards are handicapped for want of funds and it would not be a sound policy to spend the available funds on medical inspection of children in preference to improving schools. Clean schools have also their educative value and are likely to make a mark on the impressionable minds of children and influence them to personal cleanliness.

The next point to consider is the education of the teacher in hygiene, because progress in these matters cannot be made without an intelligent understanding on the part of the teacher. For this, hygiene must be taught by experts in the normal schools. In England medical inspection was started after the schools had been built on sanitary lines and compulsory education had been introduced.

When, however, we have made sufficient progress and time is ripe to introduce health inspection, I think this should be entrusted to lady doctors in preference to men for all girls' schools and boys' schools up to middle school. We all know the influence exercised by women in India in domestic sanitation, and if any good is to accrue from our efforts, we have not only to detect diseases in children but approach their mothers and instruct them in prevention and treatment of diseases. This can only be done by lady doctors. If the lady doctors are entrusted with all girls' schools and middle schools, then the Health Officer can take charge of the few remaining high schools.

The papers on "The unhygienic and insanitary condition of boys' and girls' schools in cities," by Rai Bahadur Gopal Das Bhandari, and on "The education of teachers and children in hygiene,"* by Captain Stiles Webb, were taken as read.

* Volume II.

SECTION B.

Second Session.

The Hon'ble Major J. C. Robertson, C.I.E., I.M.S., Presiding.

Conservancy.

Major Cook Young introduced his paper on "The prevalence of flies in Delhi and their reduction"* of which the following is a summary :—

At the outset the general methods of conservancy were improved and stricter supervision exercised. Dumping grounds were reduced in number, definite sites fixed, and any rubbish that could not be burnt was covered with one foot of earth. The trenching grounds were closely supervised. Incineration was started at collecting depôts and latrines in the city. In spite of these and other improvements on similar lines, as far as the reduction in the number of flies went, there was little tangible result.

It was clear that the numerous breeding-grounds within the city must be dealt with, and it was not till thoroughly organised and systematic measures were specially planned and adopted that any impression was made on the number of flies.

The breeding-grounds within the city,—stables, cowsheds, back-yards of houses, airless gullies, private house latrines, sites of ruined buildings, areas around food shops,—were all attacked. Regularly and systematically, street by street, lane by lane, the specially trained staff went round. Cleanliness was insisted upon, rubbish was burned, the ground dug up, levelled and treated with pesterine. Stables and cow-sheds received special attention, floors were made pucca and drained, litter was burned, and manure promptly buried. The flies disappeared—they were starved out.

The author concludes by expressing the opinion that the reduction of flies in a city is not a difficult matter, but it requires prolonged, systematic and detailed attention. Incineration plays no small part in the success of such a campaign.

In introducing the paper Major Cook Young said "to such an assembly as this, it would be presumption on my part to discuss the important part the domestic fly plays in any sanitation campaign in this country. But, since in Delhi perhaps more than in any other city in Northern India, organised effort has been directed towards fly reduction, I may perhaps be permitted to give the results of my experience in the new Capital of India. I may say in starting, that the lines of the campaign were laid down, only after much thought and consideration had been given to the subject. In this connection the Sanitary Commissioner with the Government of India evinced the deepest interest and I must express my gratitude for his sound advice, and, more than anything else, his clear diagnosis of the situation and its needs.

I have dealt in my paper with the methods adopted, which I venture to say have met with a certain measure of success. In the carrying out of the work, an opportunity was of course provided of studying closely the life habits of the domestic fly.

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* Volume II.

Breeding areas were found in curious places, *e.g.*, under the Pulias or stone crossings over the drains, fertile breeding-grounds were found. Again under large stones propped up against houses as steps to the entrance, flies were found breeding in the damp earth there. These steps remain for months on end in one place without being moved, and it was very interesting to find that under such there was a rich soil for flies to breed in.

My experience, I may say, has merely confirmed what has already been written on the subject.

It would be of great value to have definite information as to the length of the life of flies under different conditions of temperature and surroundings. I have had no time to make such observations, but it would appear that the average length of a fly's life is about 3 weeks, under the most favourable conditions. I was led to this conclusion by the observation that whenever there was an increased wave of prevalence, it never lasted more than 3 weeks, the external conditions remaining the same.

The age at which flies first lay their eggs would be another interesting subject of investigation. Griffith puts it at 10 days, and he adds that flies lay fresh batches every 10 days. The enormous number of flies, when very prevalent, in my opinion, however, suggests that the female fly lays her eggs before the tenth day or oftener than every 10 days, otherwise, the only explanation for these increases, is, that the life of a fly is longer than 3 weeks ; this my experience has led me to doubt.

The distance flies can travel unaided is another interesting question. They of course can be carried great distances, but I do not think that by their own effort they travel very far. At any rate, they will never travel far from their food, and my experience has been that if we exterminate their breeding-places, near their known haunts, their number cannot fail to be reduced. I have seen flies very prevalent in one part of the city, whilst two miles away, at a place which had had special attention with regard to fly reduction, there were none, though the local conditions were the same and continued so. Flies probably do not voluntarily travel more than half a mile. Graham Smith found marked flies seven hundred yards away from a spot in which he had set them free.

The campaign in Delhi is described in my paper, and I would commend to any one taking up similar work, Dr. Halford Ross's work on the "Reduction of Domestic Flies." From it much sound information may be derived. In more than one direction I proceeded on the lines he lays down, and I have proved their wisdom."

Mr. G. P. Robertson introduced his paper on "Pail latrines and a plea for the sweeper," in which he pointed out the usual defects of existing types of pail latrines and gave a specification for a good latrine. The Darjeeling type pail latrine was described and quotations given of its cost. The method adopted in Darjeeling for handling pail latrines was also described and it was shown how bad handling can nullify the advantages of a good latrine and that it pays to arrange things for the convenience and comfort of the sweeper. He exhibited a sample latrine pail that he had designed. He said that the main point in the design of these pails is that everything should be as easily cleaned as possible.

Major J. L. Marjoribanks introduced his papers on—

(1) The Nasik system of pitting night-soil to ripen it for sale to cultivators,* and

(2) The pitting of night-soil and manure in private compounds.*

A description was given of a method of disposing of night-soil and manure by means of a system of pitting within the precincts of private compounds. The method is simple, inoffensive, rapid and successful.

* Volume II.

The essential point is that householders should supervise and interest themselves in the sanitation of their own compounds.

The Nasik system of pitting night-soil is described. Briefly, this consists of its disposal in crude and liquid form into a regular system of pits. The pits are covered with a layer of *katchra* only, which forms an efficient air and fly seal. The method can be applied all the year round. Heavy rain does not interfere with the management of a system which treats night-soil to start with as a liquid. After a year or so the contents of the pits, dried and ripened, is very like ordinary earth in appearance and is in demand by cultivators.

He said :—I think it may be said that we are fairly near to success in any method if we can be satisfied, after careful personal observation, that no objectionable smell is created, and that flies are not bred, and that we can then afford to find satisfaction in the fact that the nitrogen is actually used for agricultural or horticultural purposes. There are one or two small points on which I will lay stress. The pits which are actually used at Nasik might very well be called trenches, but I am particularly anxious, in view of the criticisms that have been made, thoroughly to distinguish between the system of pitting and the system of trenching, because the word trenching has practically a single definite meaning. It signifies the application of the excreta to the superficial layers of the soil for immediate cultivation. This has been far otherwise than a success from a sanitary point of view. It has also the disadvantage that during the monsoon it is exceedingly difficult to carry out. A feature of the experiments which we conducted at Nasik which was rather a surprise to those who carried them out, was that earth was not required to cover the night-soil and that *katchra*, *i.e.*, rubbish, not only would cover the night-soil, but constitutes an air seal This is practically proved by the fact that the air seal bursts in places during the first day or two, and that the night-soil dries very slowly indeed. One great thing in connection with the work at Nasik has been that it thoroughly recognises that the night-soil of a town in Western India, which contains a considerable Brahmin population, is not a semi-solid but a liquid. There is no possible question of incineration of this liquid. Incineration was given a good trial at Nasik and it was found impossible to provide the labour required for it. One small detail has to be attended to if the system is to be carried out successfully, and that is that the night-soil is best poured into the pit by means of a trough placed under the night-soil cart. Anyone who has ever tried will find that it takes a very long time to get bullocks to back a few inches and the use of the trough makes all the difference between being able to do the thing in a clean way and in a messy way. I took a photograph of such a trough, and I shall be glad to give a copy to anyone who is interested in the subject.

The President, The Hon'ble Major J. C. Robertson, said that the subject of fly prevention was at the root of much of our public health work in India. They had read the papers by Majors Marjoribanks and Cook Young, both of which dealt more especially with flies and their breeding. The other paper by Mr. Robertson also dealt with this subject though in a less degree. The whole subject was very important and he hoped the discussion would be a full one.

Dr. A. L. Shroff :- With regard to the occurrence of flies, I should like to say a few words about their prevalence in Karachi. The fly nuisance there is so great that it would naturally lead to the problems of cholera and typhoid fever. I quite support Major Cook Young. Last year I carried out the suggestions which Major Young has detailed; rubbish was immediately removed and incinerated, and all the meat markets and other slaughter yards were treated with pesterine. As the filthy habit of throwing rubbish in the public streets has increased flies to a very great extent, it is necessary to remove immediately the rubbish and incinerate it. . . . .

DR. A. SOUZA :—I am afraid the system proposed by Major Marjoribanks will breed a lot of flies unless two sweepers are employed at each latrine, and they keep constant watch by turns, and bury the filth immediately so that no flies are able to lay eggs on it.

The other day I tried the following experiment :—

In a pit 2 feet long, $1\frac{1}{2}$ feet wide, $1\frac{1}{2}$ feet deep, I put 2″ night-soil (solid) sprinkled two ounces of Pearson's Antiseptic Fluid, covered it with 2″ of sandy soil, added another 2″ night-soil, *plus* 2 ounces of Antiseptic Fluid and filled the rest with earth. In all there were 4″ night-soil, 4 ounces of disinfectant and 12″ of sandy soil and yet 785 flies bred out of it.

The best system that can be suggested for private compounds where cartage is not available or is avoided, is to incinerate the night-soil with the compound rubbish. The rubbish will not be enough to reduce the night-soil to ashes, but it will raise its temperature sufficiently to kill the intestinal micro-organisms and fly eggs. Then the partly sterilized night-soil can be buried without any harm.

MAJOR W. W. CLEMESHA :—I think a very important point has been overlooked. In the first place it has been very clearly brought out that flies lay their eggs while the night-soil rests in latrines. Although for many years to come, the hand removal types of latrine must remain for a large portion of India, it seems to me that the proper course is to go to the root of the whole trouble and whenever possible to do away with this truly iniquitous system of hand removal latrines. I quite admit that for small towns, an underground drainage system is entirely out of the question generally on financial grounds, but large cities would be wiser to go in for more satisfactory arrangements.

THE HON'BLE MR. J. P. ORR :—I am very much interested in Major Marjoribanks' papers upon the Nasik method of disposal of night-soil. Many years ago when I was on special duty for the purpose of drawing up model rules and bye-laws for the Bombay Government, I had occasion to visit Nasik and certainly the night-soil depôt there was a horrible nuisance and it was supposed that we should never be able to reduce that nuisance. I hear now for the first time of these successful efforts to remove the night-soil, and what is of equal importance is that by this method you remove the night-soil, and yet you retain the use of that night-soil a year later for the purposes of manure. That is one of the most important advantages which the incinerator has not. I should like to see this method tried in other municipalities and I think that we want information on certain points which perhaps Major Marjoribanks will be able to supply in his reply, or perhaps he would let us have it later on. In the first place, the information that I have received from other municipal towns is that they find it extremely difficult to get people to allow them to remove their *katchra* because they want it for their own use as manure. Poona is one of the towns in which I got that information; I suppose there is a great deal more of irrigated cultivation there than there is in Nasik. But a point on which I want information is whether Major Marjoribanks found any difficulty in getting the *katchra* conveyed to the night-soil depôt. Another very important advantage about this system, the absence of which prevents municipalities in many cases from dealing properly with night-soil, is that the night-soil need not be taken to great distances because there is no nuisance. The trouble in many places, especially in Poona, with which I am better acquainted than any other town, is that if night-soil be dumped in places near the city a fearful nuisance from flies and a smell will result. I understand from Major Marjoribanks that this simple system both abolishes the fly nuisance and abolishes the smell nuisance. But I do not quite understand one point. Properly speaking each day should have its own pitting for its night-soil, which is sealed by the *katchra* on the evening of the day on which it has been used. What I want to know is how long after the night-soil is put in, is the *katchra* put in? There must

be I suppose a certain interval, but probably the Nasik people have got some arrangement by which they can make that interval very short. Otherwise I should think there must be a nuisance from smell, though that nuisance can be got over. Then you can instruct poorer municipalities to make their night-soil depôts quite close to the town and that immensely reduces the expenditure, because it is the cost of cartage that stands in the way of the proper disposal of the night-soil in many small municipalities.

I don't understand this paragraph in the paper: "The contents of a pit may shrink so much in drying that there is room for a day's night-soil on the top. This should never be applied however to a pit whose contents have only half dried." Will Major Marjoribanks kindly explain that in reply? Another great advantage of course is that the process can be carried on even in the course of the monsoon. In fact, as far as I can make out, the monsoon rather helps the matter. I think municipalities who wish to adopt this system will also want some information on these points. What is the area of pits required per month? What is the cost of diggers? And what is the cost of haulage, and from what distance? All these questions come into the financial aspect of the affair and require to be investigated. Perhaps Major Marjoribanks has not got these details, but he could give us some kind of estimate later on, which could be supplied to our municipalities for their information.

THE HON'BLE SIR PARDEY LUKIS:—There was one point mentioned in connection with Major Cook Young's paper. I notice he talks of the free use of pesterine. Pesterine of course is a petroleum derivative. I see in the "Journal of Applied Entomology" that if rubbish and litter, which is intended afterwards to be devoted to the manuring of gardens, is treated with any petroleum derivative, it loses its value and in fact becomes absolutely hurtful to flowers. If litter is intended to be ripened for garden manure either milk of lime, small quantities of sulphate of iron, or alkaline solutions should be used instead of petroleum derivatives.

MAJOR MARJORIBANKS, in replying said:—I will deal with one or two of the points which Mr. Orr has raised. At Nasik there is no difficulty in getting people to give up their *katchra*. The population does not happen to contain a very large number of cultivators. There are a fair number of market gardeners. The market gardeners do not take the trouble to use *katchra*. They are very much fonder of stronger manure, in the shape of night-soil. There may be many places where there might be some difficulty about *katchra*, but I cannot say that I found that at Nasik. I have spent a good many years in travelling round small municipalities in the Deccan and on the whole I do not think that most of the *katchra* is used up by private individuals.

As regards the question as to what time of day the *katchra* is put over the night-soil, it should be remembered that there is no use whatever in mixing night-soil with *katchra*. The *katchra* is merely put on the surface as an air seal, and accordingly it is simply a matter of putting on the *katchra* after the last cart has come along. Till then there would be a very slight smell, but that smell is the smell of perfectly fresh night-soil. What is really offensive is the smell of night-soil which has been exposed for a good many hours, and by the evening when the *katchra* has been applied there is no longer any smell. I may mention, as regards the actual air sealing, that after the last rains I paid a surprise visit to the depôt at Nasik, and I thought I should like to see that day's pit. I happened to come in rather late in the evening. It was pretty dark. I was not able by the sense of sight to determine which was that day's pit, and I was perfectly unable by the sense of smell to determine it. As regards the area per month, that of course would depend upon the population and upon the amount of night-soil afforded by the population. Again we could not say that the amount of the night-soil of the population of one town

and another would be in any way constant, because of the very great variation in the amount of ablution water used by particular castes. Towns containing a large number of Muhammadans would not have so fluid a night-soil as those containing a large number of Brahmins, and so it is impossible to give any definite figures of that sort. Again the cost of haulage, which is a very troublesome item, is one about which I have no figures. That is a matter which will have to be locally worked out. Of course the system does not pretend to do away with that horror of India—the iron-clad. And certainly I have never attempted to recommend this system where a drainage system could be introduced. Where a water carriage system could be introduced we would be only too glad to get rid of any system of the kind. It is only intended for towns which are not able to have a water carriage system and, in spite of their horror of them, continue to have iron-clads. It is merely a method of getting rid of the contents of these iron-clads in as inoffensive a manner as possible.

MR. ROBERTSON said that he did not see why any nuisance should arise from iron-clads if his system of pails was adopted, because the pail as soon as it was filled would be emptied into the cart and removed, and there should be no nuisance caused by the carting of fresh night-soil in the streets.

MR. T. SALKIELD :—I should like to ask if any of you have had any experience of the sulphuric acid treatment of peat in the disposal of night-soil. Some years ago I had charge of a district in England, a portion of which had no sewers, and this system was adopted with excellent results. It is so long ago now that I cannot give you any figures or detailed facts but I have an idea, after listening to these speeches, that if it were possible to obtain peat in this country, or a suitable substitute, and you were to adopt a system of adding sulphuric acid to it and putting it in the pails and then sending round men to collect these pails, I think a good many of your troubles would be solved. I am not a sufficiently expert chemist to talk about the fixing of nitrogen, but I have an idea that the sulphuric acid fixes the nitrogen or converts the solids into a non-putrescible condition and renders the contents of these pails very valuable for manurial purposes. I think that if any of you could make a study of this matter it might possibly repay consideration. "A note on Incineration in India,"* by Captain H. G. Stiles Webb, I.M.S., was taken as read.

* Volume II.

SECOND DAY—TUESDAY, 20TH JANUARY.

SECTION A.

THE HON'BLE SIR HARCOURT BUTLER, K.C.S.I., C.I.E., I.C.S., PRESIDING.

(a) *Infantile Mortality.*

THE PRESIDENT:—The first paper on the agenda is by Miss Benson on "Proposals for the formation of a Women's Domestic Sanitary Service for India." * This was the result of a meeting held a few days ago in Delhi and the paper was not received in time for me to refer to it in my opening address, otherwise I should have done so. Miss Benson is not able to be present, so we shall take the paper as read.

Mr. P. L. MOORE then introduced his paper on "Nurse district visitors in Madras City,"* in which the author briefly summarises the work done by six nurses who were employed on a maximum salary of Rs. 200 in connection with malaria preventive measures in the northern portion of Madras City.

He said he attached no great value to the figures given in the paper. He merely thought that such figures as were available should find a place in the paper.

The only other remark was that, since writing the paper, Madras had had the benefit of a visit from Captain Hodgson to deal with malaria in the city, and he would be very glad if Captain Hodgson would give his opinion as to the value of the services of the nurses.

CAPTAIN HODGSON said he had recently taken over the anti-malarial work and he had seen the work of these nurses. The great point about the nurses was that they actually visited the homes of the people. There were large numbers of people who would never go to a dispensary because, in their ignorance they thought they would be operated on, or that measures would be taken against their houses or their homes because they had got an illness. The nurses had been able to impart a certain amount of confidence to the people, so that not only were the people actually treated by them improved, but large numbers of women and children who would otherwise never have gone to a dispensary, did actually go for treatment He thought this was very important because there was undoubtedly a very large amount of opposition to treatment in malaria. If men were employed in this work they were unable to enter the houses. Of course, it was only the very best type of nurses that could be used for this work, because it was essential that they should obtain the confidence of the people. It was entirely a question of confidence. Once the people had confidence they came for treatment regularly afterwards. He thought he could say very definitely that these nurses had done extremely good work in Madras.

MR. ORR:—"I am sorry that Dr. Turner of Bombay is not present here. In his absence I think I ought to say a word or two about the nurses in Bombay. I would like to recommend those who are trying the experiment in Madras, to consult Dr. Turner, the Health Officer of Bombay, as to his experience there and an interchange of notes might be useful. I do not know much in detail about what the nurses do, but I do know that they are considered to be doing a very useful work in the direction that

* Volume I.

has just been pointed out, that is, in getting at people who cannot be got at in the dispensaries or in the hospitals. People can be got at in their homes by nurses, and if you have the right type of women a great deal of good might be done in the way of education, and education, though a slow process, is really a very strong weapon in the hands of the sanitarian."

Dr Rozdon introduced his paper on "Infantile Mortality,"* in which it is pointed out that the question of infant mortality is one demanding the serious consideration of every hygienist. Its importance is demonstrated by a reference to the statistics of Amritsar as recorded during 1910, 1911 and 1912.

Approximately one child out of every three born, died within the first year after birth. The causes of this terrible mortality are discussed, and are shown to be chiefly ignorance, both on the part of mothers and quack midwives, as regards all matters pertaining to pregnancy, maternity and infant hygiene.

Early marriage, contagious diseases, general insanitary conditions and over-crowding are additional and aggravating contributory causes.

To aid in the enlightenment of the people and the removal of such ignorance, the author recommends that advantage be taken of the already existing panchayat system, and provincial health societies engrafted on them, and by this means spread a knowledge of Nature's laws and elementary principles of domestic hygiene. The women of India must be enlisted to advance such knowledge amongst their own sex, the women themselves are the best pioneers. A system of lady health visitors and voluntary workers would be of the greatest value.

Midwives should be trained and, if necessary, a Midwives' Act introduced based on the Midwives' Act of 1902 in England and Wales.

Municipal energies should be directed to reduce the over-crowding, and to supervise and control the trade in that most essential of infants' food—milk.

It is by systematic and organised campaign in all these directions that the appalling infant mortality can be reduced, and many lives saved to the State.

Dr. Rozdon said the paper clearly showed the number of infantile deaths which occurred every year in a town like Amritsar, and he presumed other towns had also a large number. Such mortality was too high. The next question to consider was the best means of reducing this high death-rate for children. In his paper he had proposed that provincial health societies should be formed, and lady health visitors appointed. The previous speakers had pointed out that they must have lady health visitors who would be very tactful and sympathetic towards the people they had to attend. He thought it was time for municipalities to have at least one or two health visitors. There was, of course, a great field for voluntary workers as well

As regards midwives, who, he thought, played a great part in increasing infant mortality, an Act like the English Act of 1902 should be framed by the Government. Municipalities should be roused from their lethargic sleep and requested to lessen over-crowding in big cities. Their attention should also be directed towards the milk supply. He had come across several cases of infantile mortality in Amritsar which were only due to the want of good milk. It was only by a systematic and organised campaign that they could reduce infant mortality.

Major W. H. Kenrick next introduced his paper on "High temperature as a cause of infantile mortality."* The following is a summary :—

During May and June, 1912, exceptionally high temperatures prevailed in parts of India and in the Central Provinces The vital

* Volume II.

statistics of the latter were studied, and the district returns analysed, with reference to the prevailing atmospheric temperature.

The charts and curves mapped out showing deaths of infants and children, total deaths and births, month by month, show, both for the Province and for the various districts, a rise in mortality accompanying a rise in the maximum shade temperature during the month of May, 1912. The rise in the total deaths is contributed to chiefly by the rise in infants' deaths, those districts with a higher temperature contributing more than the districts, such as Betul and Mandla which enjoy a cooler climate.

In the interpretation of statistics collected from wide areas, local conditions, or diseases, or epidemic outbreaks, may act as disturbing factors and must be considered in any attempt to show the correlation between atmospheric temperature and infantile deaths Taking into consideration all such factors and excluding the influences of cholera, plague, small-pox, malaria, measles, chicken-pox, and infantile diseases, the author shows that the daily figures indicate a greatly increased infant mortality corresponding to a rise in temperature, especially during the seven day period of the heat wave in May, 1912, and considers it justifiable to conclude that the metereological phenomenon of abnormal high temperature is the cause of the excess mortality.

Pyrexia and exhaustion are the cause of death. The mortality, to some extent, can be controlled by improved house construction, the opening out of congested areas, and the gradual improvement of the general conditions of life.

He said: In most years the total death-rate shows a rise during the month of May, and upon analysis it will be found that this rise is almost entirely due to an increased number of infants' deaths. In the year 1912 there was excessive heat during a short period of May and its effect upon infant life is shown in the charts I have given. It would be a good thing if enquiries upon similar lines were conducted in other parts of India, as the more light that can be thrown upon the causes of death the greater will be the accuracy of our returns.

Dr. Souza: My experience has been that infantile mortality is always high during the prevalence of intestinal diseases, *i.e.*, from June to August when the atmosphere is moist and the temperature not very high.

In 1912 the highest mortality among infants in Lucknow occurred in the month of August, while in 1913 July showed the maximum when cholera was prevalent.

The same was the case with Allahabad. The causes are chiefly malnutrition and improper clothing added to social conditions of the people. The mortality in these provinces is higher than in the Presidency towns, chiefly on account of ignorance.

With a view to the reduction of this mortality the Lucknow Municipality is training *dais* at the Dufferin Hospital. Twelve *dais* have already been trained at municipal expense and five *dais* are under training.

Also 30 bazar *dais* received special instructions and were paid 8 annas per attendance. Without the co-operation of the public, however, municipal efforts will be in vain. The fully trained *dais* do not get much practice, and the bazar *dais* that come in for instructions, tell Miss O'Brien, the Lady Doctor, that people will not accept modern methods but persist in having the primitive methods their forefathers were used to.

I think a society of leading gentlemen and ladies of the town for the prevention of infantile mortality is desirable. Its objects would be (1) to engage trained nurses and health visitors and supply them free of charge to the people: (2) to convince people by leaflet, etc., to demand only trained nurses; (3) to prohibit bazar *dais* from practising who have received no instructions at the lying-in hospital.

Dr. Froilano de Mello :—J'ái étudié avec beaucoup d'attention cet interessant mémoire et sans vouloir flatter l'auteur on peut bien dire que l'on y trouve d'admirables ressources et arguments statistiques.

Mais sous le point de vue médical je voudrais que l'auteur nous expliquât comment les hautes températures agissent sur les enfants. Ce n'est pas une insolation, au moins les symptômes décrits dans la dernière partie de ce mémoire n'autorisent pas un diagnostic semblable. Et si cela était la cause directe, c'est-à-dire, si les températures agrissaient par elles-mêmes sur la mortalité infantile, pourquoi est ce que les premiers âges (1 à 5 ans) échapperaient à ce fleau. Vous savez parfaitement que c'est l'âge des maladies, l'âge de moindre résistence et cependaut ces prèmiers âges ne paient pas un tribut à la mort par cette cause !

Si je vais à présent étudier la description trop resumée que l'auteur fait des symptômes de la maladie, je voir quelle se prête bien au cadre nosologique des intoxications gastro-intestinales. L'irritation, la somnolence, souvent la fièvre sont autant des symptômes des troubles gastro-intestinaux et j'appelle l'attention de l'auteur sur ce point.

Il est vrai qu'il nous dit que la diarrhée infantile n'est pas la cause de cette mortalité et que cette maladie est propagée par les mouches.

Messieurs, la diarrhée infantile n'est pas une entité morbide, elle est un syndrôme qui va de la simple indigestion jusqu'à la diarrhée épidémique. Vous savez parfaitement que les dernières études bacteriologiques donnent comme un des agents de cette diarrhée le *Proteus vulgaris*, et nous savons déja le rôle pathologique du coli bacille dans la production de ces diarrhées. Nous savons aussi la virulence que les microbes acquièrent pas des passages en série, et c'est la que je pense, c'est le principal rôle des mouches. Il s'agit donc d'une diarrhée infantile epidémique, et l'opposition que l'auteur montre entre le nombre deminué des mouches et l'augmentation de la mortalité infantile, n'est pas, je le crois, un argument puissant.

Je crois plutôt que c'est à cause des fermentations et de troubles gastro-intestinaux qui sont rares dans la première enfance parceque leur alimentation est le lait maternel, que l'on droit chercher la cause immédiate de cette mortalité donc la haute température est seulunent l'agent producteure. En tout cas, l'auteur qui a étudié le sujet nous expliquera mieux cette action.

Dr. K. C. Bose said there was not the slightest shadow of doubt that early marriages were a potent factor in infantile mortality, and in the early decay of the health of the young mother and the poor condition of her children. But with the advancement of age and the progress of education, a healthy reaction had taken place in the minds of the educated classes of their women, and they were refraining from following their old customs and most of them married their daughters after they had completed their 12th year of age, but to their regret infant mortality still continued high.

The poverty of the people, the dearness of milk, the toleration of quacks, as the author of the paper had said, were the main factors in the death of their infants. Indeed the heavy death-rate amongst their infant population was more due to carelessness and inanition than to anything else. Nearly one-third of the total deaths of the infants was due to inanition, and many were carried off by infectious diseases and diseases of the respiratory organs and bowels.

The suggestion for the bacteriological examination of the milk supply seemed to him rather chimerical.

The importance of the appointment of female sanitary inspectors could not be over-rated. The Calcutta Corporation has appointed duly qualified lady doctors, the record of whose services is excellent. They went to the houses and hovels of the poor, gave them lessons in sanitation and lent their invaluable services in emergencies.

Dr. K. V. Amin thought that high temperatures cause infantile mortality on account of the milk going bad. Another cause was the low vitality of some mothers who could not suckle their children; also they did not dilute the milk given to the children properly according to age. He would ask the Conference to consider the advisability of having milk dispensaries for large municipalities under medical men, for dispensing sterilised milk in one-feed bottles of the right dilution, according to the age of the child.

Dr. B. B. Brahmachari agreed with Dr. Bose that early motherhood was one of the causes of infantile mortality. He thought the solution of the problem lay in the education of girls. They should be able to read for themselves so that they might learn by means of leaflets and books.

Another cause was the poverty of the people which prevented them from calling in the assistance of qualified medical practitioners. The malpractices of quack midwives were the most frequent causes of infantile mortality, and it would be a boon to the people if the Conference worked out the means of placing qualified help within the reach of the poor.

The President then called upon Dr. Turner (who had just arrived) to give the Conference the benefit of the results obtained from the experiments in Bombay, in regard to nurse district visitors in Bombay.

Dr. Turner:—For the last 10 or 12 years in Bombay we have been following a line of action with regard to the education of the mother rather than of the nurse. In Bombay city there are about 160 of these native *dais* and we are now trying to get at them through the Bombay Sanitary Association. We have organized a series of lectures—we have collected these women in spite of all obstacles. We were told that they would never come to listen, and if they came, would go away quite indifferent to any lessons we should give them. We have not considered that a great bar to the success of the method. These women are, as most of you can understand, of the most unclean type. Their methods are weird and grotesque in the extreme, but they are what are called hereditary *dais*, and they are employed by the poorer class of women for want of better. The suggestions made in the paper begin from the top: we are trying to begin from the bottom. We are trying to inaugurate these lectures, and Her Excellency Lady Willingdon is, I believe, about to attend a meeting where we are going to promulgate these ideas. Fortunately Lady Mabelle Egerton, who is a member of the Central Board for control of Midwives in London, is going to address the meeting. On Friday last we collected 100 of these *dais* and addressed them in their own language, *Marathi*. A lot of them were of the Borah class, Muhammadan women, whom we were told would never accept our teaching, and would scoff at the idea of our adding to the knowledge already given them by God Almighty. However these women were so interested in this lecture that they asked for it to be repeated in Hindustani. I think you will agree that this is a step in the right direction. We are aiming at beginning at the bottom so as to go among the houses of these poorer women and try and create amongst them a demand for better methods No doubt it will be difficult, but everything of that sort in India is difficult, and it is only a matter of time and trouble. There are, as probably some of you know, Municipal dispensaries in Bombay which have been in existence for 10 or 12 years in each of which there is a municipal trained nurse. In addition to that the Bombay Sanitary Association has a staff of health visitors who go about to these women, teaching them as far as they can domestic hygiene, the care of the child, and of the mother. The Corporation of Bombay have now voted the sum of one thousand rupees a year towards providing the poorer mothers with assistance

during the lying-in period. They give them a bed and a certain amount of milk to carry them over the period of labour.

(b) Notification of Diseases.

THE HON'BLE SURGEON-GENERAL SIR PARDEY LUKIS :—Before the subject of the notification of disease is introduced I want to make just one remark. Beri-beri is not included in our agenda, but I see in the admirable paper on the notification of disease by Dr. de Mello, that he has expressed a strong opinion that beri-beri is not in any way due to rice, that it is both infectious and contagious, and that in his opinion it ought to be made a notifiable disease. In view of this fact and in view of the very varying opinions that have been expressed in the medical press lately with reference to the deficiency theory, I think it would be as well if the delegates would discuss this question, because it seems to me quite possible that under the head of beri-beri we may have included more than one disease. I heard the other day from Colonel Blenkinsop that when he was in Sierra Leone he had several officers under his treatment, all suffering from clinical beri-beri, but that in not one of these cases was he able to detect any evidence whatever of dietary deficiency. Recently too, there has been an outbreak of what appears to be beri-beri among the British troops at Lebong. This outbreak has been confined to privates, none of whom are rice eaters, and the majority of whom are teetotalers, so that it is a little difficult to understand where dietary deficiency comes in. The outbreak is now under observation and the report will be looked forward to with much interest. Major Greig went up to investigate it, but I don't know if he will consider that he is entitled to say anything about it at this stage, though we should like to hear what he has to say.

The first paper was by Dr. de Mello on "What are the diseases whose notification should be rendered compulsory in Portuguese India,"* of which the following is a summary :—

In the part of Goa known as the *Velhas Conquistas*, all sanitary measures are practicable on account of the large number of medical men, other than health officers, who practice their profession there. So much cannot be said for the *Novas Conquistas* where there are very few doctors for a very large area.

The subject is divided into two parts—

A.—Diseases of a known nature.

B.—Diseases of an unknown nature.

In the first group the author mentions—

I.—Plague, and suggests the necessity of making notification compulsory when averred cases of plague occur among rats.

II.—Diphtheria, and

(*a*) calls the attention of medical men to the multiple forms in which the disease may appear, and to the relative rarity of this disease in India when compared with European countries, and

(*b*) suggests that the notification of all suspicious sore throats should be rendered compulsory.

(*c*) In confirmed cases of diphtheria all the measures of prophylaxis and notification in use in European countries are applicable to India.

III.—Typhoid and paratyphoid infections should be notified and also influenza

IV.—Cholera in Goa is discussed and reference made to *cholera de reviviscence locale*, commonly called *cholerine* or choleraic diar-

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rhœa. This name *cholerine* should no longer survive, because in the first place it leads to confusion, and in the second the author has isolated a true cholera vibrio from the stools of three patients suffering from it.

The author insists on the need for settling the question of cholera carriers, and on the necessity for the compulsory notification of all suspected diarrhœas.

V.—Tuberculosis:

(*a*) a disease of the individual,
(*b*) a social disease.

The former includes—

1. The *tuberculisés.*
2. Extra-pulmonary tuberculosis (meningitis, pleurisy, etc.). These need not be notified unless they show an appreciable bacillæmia.

Amongst the patients of the second group (*b*) who ought to be notified, the author includes all cases of pulmonary tubercle whatever may be the stage of the disease.

(*a*) Notification should be made compulsory in all cases of—
pulmonary tuberculosis,
laryngeal tuberculosis,
non-latent extra pulmonary tuberculosis,
latent extra pulmonary tuberculosis in which a tuberculous bacillæmia is disclosed.

(*b*) That other cases of tuberculosis should receive the careful attention of doctors in order that the source of infection may be sought in the patient's surroundings.

(*c*) That the doctors of India should carry out studies on the degree of tubercle bacillæmia in the different forms of tuberculosis, and on the clinical extent and pathological anatomy of the *typhobacillose* of Landouzy.

(*d*) That Governments, municipalities, and philanthropic associations should strongly encourage anti-tuberculosis campaigns.

In the second part of his paper the author discusses diseases, the nature of which is up to the present unknown.

I. Amongst these, one disease which he believes to be infectious and contagious, and not produced by feeding on rice as was proclaimed at the last International Medical Congress in London, is beri-beri. His paper describes in detail the different epidemics of beri-beri in Goa, which according to the author is an imported disease.

II. He describes at length remittent fevers of an unknown nature similar to those of British India, gives a clinical resumé of the disease for which he is indebted to Dr. W. da Silva, and a bacteriological resumé of two cases, and proposes:—

(*a*) "That further research should be made to clear up certain obscure points";
(*b*) "That these remittent fevers should be added to the list of those whose notification should be made compulsory."

III. He describes small-pox in Portuguese India, the influence of the non-Christian classes of the population in its propagation because this disease is one of their goddesses, and proposes:—

(*a*) That notification of small-pox should be made compulsory;
(*b*) that rigorous penal measures be enforced by Governments in cases of concealment of small-pox.

IV. Finally he advises compulsory notification of measles and whooping cough which are especially fatal to children, and hopes that the efforts of Governments and municipalities will tend in the direc-

ion of one day making disinfection compulsory in all cases of death unless the doctor declares such to be unnecessary.

Captain Norman White in introducing Dr. de Mello's paper cordially reciprocated his sentiments towards his British Indian colleagues. Dr. de Mello's difficulties with regard to the compulsory notification of diseases in that part of Goa known as Novas Conquistas had their counterpart throughout the greater part of British India. He thought the paper a very valuable one inasmuch as it gave the Conference information about tropical diseases as they are found in Goa. From the medical point of view Goa had so far remained a *terra incognita* to most of the delegates. Of special interest was Dr. de Mello's description of beri-beri in Portuguese India: the author had made out a strong case that the disease was of an infectious nature But on this point there were varying opinions and he would leave it to the Conference to discuss the matter.

Lieut.-Colonel Drake-Brockman:—In my note* on this important question of notification of diseases, I have gone into details of a method I advocate, at any rate as a commencement, in this difficult sanitary problem—it is briefly this, that until such time as we can ensure the active co-operation of the public themselves as well as the medical profession generally—especially in our large cities, this duty must be taken over by the executive sanitary authority responsible. Some such method as that advocated for this purpose should be adopted, if we wish to keep in touch with what is going on in the way of disease in our large cities. An agency is absolutely necessary in order to keep us daily and hourly informed of what goes on, and it must be guided by medical men. The main object in having a person of the rank and prestige of a medical officer for this purpose is two-fold—firstly, it ensures an accurate diagnosis of the outbreak and an intelligent enquiry into its possible origin, and secondly, the people themselves are saved much unnecessary worry and possible oppression in many little ways at the hands of petty municipal and other menials. I have personally seen good results from the method suggested, and it is of course capable of modification or extension as circumstances demand, but in advocating such one cannot ignore the fact, that in the absence of legislation to ensure the full value of a system of notification, we must in very large measure rely upon the good will and active co-operation of the medical profession generally. I am personally of opinion that the enactment of a Medical Registration Act in India more or less generally, will, besides being beneficial in other and various ways, go far towards helping us in effectually tackling this difficult sanitary problem; for though I am by no means a pessimist as regards the sanitary awakening of India, I feel that this matter is *most urgent* and one in which for the present it is useless to expect any very material assistance from the masses of the people.

Dr. Bose introduced his paper on "Notification as a means of prevention of the spread of infectious diseases,"* and said, "the scope of this short paper is to establish the fact that by the timely notification of the appearance of an infectious disease we can effectively arrest its spread. More than 40 per cent. of the total number of deaths of our country are due to preventable diseases. The time has come when the notification of infectious diseases should be made legally compulsory. Taking into consideration the upward rise of the line of phthisis in the table of death returns of a town or city, it becomes imperative that it should be included in the list of notifiable diseases. Public health is public wealth. The spread of leprosy should be restricted by notification. The law regarding the segregation of lepers is very elastic. My apology for including purulent conjunctivitis is simply to guard against its spread amongst the

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inmates of a school or hostel The advantage of a notification act can never be overrated."

Dr. B. B. Brahmachari agreed with Dr. Bose that it was high time to make the notification of infectious diseases compulsory at least in municipal towns, but as to the notifying agency Dr. Bose was not explicit. Qualified medical men when they treated such cases would, of course, report them, but judging from reports the majority of patients went without treatment or were treated by quacks. In such cases the duty of reporting infectious cases would rest on householders, but as householders could not very well notify diseases which they did not recognise, the notification would have to be limited to such diseases as they could easily recognise, *i.e.*, small-pox, cholera and plague, the three most destructive diseases in India.

Dr. Souza read the following note :—"Small-pox, cholera and plague are the notifiable diseases in the United Provinces. I have noticed however that in some municipalities this bye-law is a dead letter. For instance, in Allahabad the bye-law was enforced after I had brought it to the notice of the Chairman. Similarly in Lucknow the bye-law was enforced only last year.

In my opinion the bye-law should be properly enforced in all the municipalities, and tuberculosis should be added to the above diseases.

British India is not sufficiently advanced for the notification of all infectious diseases.

Almost two-thirds of the people are attended by hakims and vaids, and I doubt whether they can be expected to give reliable information. They will only throw more work on the Health Department.

The Portuguese population consists largely of Christians, and hakims are scarce there. Notification of the diseases mentioned could be very well carried out in Goa, but the country lacks the proper organization of a Sanitary Department, and unless this want is supplied, notification would be useless."

Major E. D. Greig referred to Dr. de Mello's paper with regard to *beri-beri* and asked the following questions :—

(1) If the cause of beri-beri has an alimentary origin (toxic or inadequate diet) and more especially husked rice, how can we explain beri-beri amongst those people who do not eat it ?

(2) How explain certain cases of the disease in those countries where the consumption of rice is relatively very small ?

This question of associating the cause of beri-beri with polished rice had led to a great deal of confusion in connection with deficiency diseases. Rice was important for the reason that it formed the dietary of millions of Eastern people, and naturally formed a very important factor, so that defects were brought out very prominently ; but apart from rice altogether, all the symptons of beri-beri could be produced in a dietary which contained no rice whatever. The investigation in the Philippines, of Smith and Crowell, show that a dietary which contained little or no rice can within three months produce all the typical symptoms of beri-beri. The work of Anel Holst also supports this. The reason that other dietaries bring about the disease is that they are deficient in certain essential constituents. For example, beef, which is a very important article of diet, has not a very great many of essential constituents (which we call vitamine) in it. Major Clemesha can tell us of a school in Kurseong in which the boys were feeding on a very poor quality of beef and developed beri-beri. But on giving them a properly balanced diet containing sufficient vitamine the disease was eradicated. This would point to defects in diet being the cause of these symptoms. He thought it best to regard this group of diseases—epidemic dropsy, ship beri-beri, and scurvy—all as types of deficiency diseases, and with that mental conception one had a better chance of

eradicating the disease. The whole trend of modern research, experiments of which have been carefully planned and carried out, exclude the infectious theory.

He had investigated an outbreak at Lebong, but he could not say more about that than that he found that the persons attacked belonged to a group of men living on a deficient dietary, while those on a different dietary altogether were immune from the disease. He thought the whole question of metabolism needed further working out on present lines. It would be well, for example, to find out what articles of dietary are defective in vitamine, and what have a large amount, so that in the cases of large bodies of men such as among troops, in jails, etc., a suitable dietary not dangerous from the beri-beri point of view could be given. Other articles of diet than rice could bring about the same disease.

A man in Berlin who fed himself on a dietary defective in vitamine produced all the symptoms of beri-beri ; so that in Berlin where there was no possibility of infection, beri-beri was produced. All modern research supports the view of deficient dietary being the origin of beri-beri.

Major Clemesha continuing the discussion referred to the epidemic in the school at Kurseong, and stated that the dietary there had no doubt been deficient owing to insufficient Budget provision, and cases had occurred every few years. Some extremely interesting facts had been obtained from this school. The head-master there has been in the habit of weighing the boys every three months for the last 10 years. He (Major Clemesha) was at present engaged in analysing the results of these weighments, and hoped shortly to publish a note showing the extreme value of weighments at school as a test of efficiency of diet in general. Since the introduction of a change of diet into this school there had been a very great alteration in the curve of the increase of weight in the boys. He thought there was no doubt that carefully investigated epidemics of beri-beri would always show that it was a deficiency disease. He thought it desirable to make beri-beri a notifiable disease in order that sanitary departments in various provinces might have an opportunity of investigating these diseases when they break out.

Dr. U. N. Bramachari supported the dietary origin of beri-beri.

Captain Gill wished to ask Major Greig how if defective diet was responsible for beri-beri, there was no beri-beri in England where a certain portion of the people suffered from defective nutrition.

Major Greig explained that there had been a typical outbreak of beri-beri in Dublin. In Germany, England and elsewhere persons on a deficient dietary had developed typical symptoms of tropical beri-beri.

Dr. de Mello considered that the deficiency theory could not possibly explain the epidemics of beri-beri which had occurred in Goa and he maintained the attitude he had taken up in his paper that beri-beri was an infectious disease. He said : "Je suis entre deux opinions differentes : celle du Dr. Clemesha dont je connais très bien et je sais les travaux sur l'analyse des eaux, et celle du Dr. Greig dont je connais un excellent livre que je fais étudier à mes étudiants.

Le Dr. Clemesha veut que le béri-béri sait notifié au moins pour que les medicins l'étudient mieux que jusqu'à présent. C'est bien ; c'est la l'opinion du Congrès de Londres, mais le Dr. Greig pense que le béri-béri n'est pas une maladie infectieuse et qu'il est causé par une insuffisance alimentaire, quelque que soit le régime, riz ou autre.

Je m'oppose en absolu contre cette dernière opinion. Comment donc les indigènes de l'Inde Portugaise que se nourrissent si mal n'ont jamais contracté le béri-béri ? Comment est-ce que cette maladie accommence chez les marins du Portugal qui s'alimentent cent fois

mieux que les indigènes ? Comment est-ce que les soldats africains lui payent tribut malgré leur ration alimentaire et malgre le changement de régime ?

Le béri-béri n'est-il par contagieux ? Comment expliquerez-vous que les enfants le contractent par le lait maternel ? Vous ne medirez pas certainement que le lait change de composition dans ses éléments essentiel d'après les régimes.

Vous ne pourrez pas expliquer comment un soldat faisant le service de factionnaire ait contracté cette maladie, alors qu'il faisait ce service dans la forteresse d'Aguala où l'on avait enfermé des prisonniers béri-bériques.

En apportant ici cette question, je n'ai pas voulu que m'opposer devant cette Conference aux idées des congressistes à Londres sur la question du béri-béri.

Messieurs, vous vous rapellez très bien avant la découverte de l'hématazoaire c'etait le mauvais air qui donnait la malaria ; avant la découverte du trypanosome c'était la *mandioca* qui causait la maladie du sommeil. Nous sommes quant au béri-béri dans la même époque que nos prédécesseurs avant la découverte des agents du paludisme et de la maladie du sommeil ; attendons la découverte de l'agent béri-bérique, mais avant que cela se fasse, gardez-vous bien de proclamer la non-contagiosité, la non-infectivité du béri-béri.

(*c*) *Tuberculosis.*

Dr. W. J. Wanless introduced his paper on "Tuberculosis in India—some suggestions on its spread and prevention,"* in which he pointed out the apparent increase in the disease and its widespread prevalence among the educated and artisan classes of large towns, and also among the village population.

The famine of 1900 and annual plague outbreaks had left a legacy of the disease. Villagers in search of employment migrate to Bombay or large towns, contract the disease in the overcrowded chawls, and return home to spread infection among their families and neighbours.

To prevent further spread, to grapple with the scourge, conditions must be improved, ignorance must be dispelled. Education is the most urgent need. A popular and extensive campaign by means of leaflets and lantern lectures should be undertaken, medical inspection of school children, the teaching of elementary hygiene are necessary adjuncts, sanatoria should be established, expert training in diagnosis and treatment should be given to Assistant Surgeons and Sub-Assistant Surgeons.

A popular appeal for subscriptions to a *large central fund*, for use in a grand anti-tuberculosis campaign should be made. All officers —missionary, medical and sanitary,—should combine and heartily co-operate in a campaign for the improvement of the sanitary and hygienic education of the people.

Dr. Wanless said that tuberculosis was greatly on the increase in India. His own experience and what he had read in the reports of mission hospitals, clearly pointed to this increase and he believed that one of the factors which accounted for the increase in many of the villages of Western India had been the effect of famine and plague. Large numbers of people during these times migrated to Bombay in search of employment. Not being brought up in that climate their power of resistance seemed to be lowered and there they contracted the disease which, on their return to their villages, they spread among the people. He was personally concerned only with villages. The problem was comparatively easy in the large towns, but how to combat the diseases in the smaller villages was a very serious problem for the reason that a very large number of these people never saw a doctor at all, did not report to the mofussil dispensaries

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in the large towns, and were medically seen by nobody. He thought some form of visitation or notification of the disease was needed in these villages. Two sanatoria had been established in the Bombay Presidency, but unfortunately they had been established in places where they were not available during the rainy months. He thought sanatoria should be established in places where they would be available throughout the year. He referred to the work done by Sub-Assistant Surgeons in these small towns and thought that tuberculosis shelters ought to be attached to every dispensary and small hospital. These shelters would not cost much and would help a great deal in combating the disease in small towns. He emphasised the magnitude of the problem and expected much from the education of the masses. Villagers, and even people in large cities, knew little or nothing of sanitation or personal hygiene and it was quite a common thing to find corners of rooms in chawls, and elsewhere, full of expectoration. This was proof enough that the people knew nothing about the spread of tuberculosis being due to expectoration. He hoped a great deal of emphasis would be put upon this campaign in this country with regard to the combating of this terrible disease, which he believed to be the worst of all the great enemies in the country."

MAJOR SPRAWSON thought that tuberculosis wards were preferable to shelters which, in the United Provinces, could not be efficient unless they were protected from dust, wind and heat.

DR. NEWELL referred to the question whether the increase in tuberculosis in India was real or apparent. Recently in "Public Health" there appeared a very interesting paper by the Health Officer of Glasgow, who traced the prevalence of phthisis in Scotland for over 20 years and showed how during that period phthisis had changed in its locality in the various counties of Scotland, due to changes in the industrial centres. Dr. Newell thought that possibly something like that was going on in India. With a view to finding out the prevalence of the disease in the city of Lahore he had recently done a certain amount of voluntary examination of clerks and school children, and perhaps others might be able to give the Conference their opinion as to the prevalence of the disease in various centres. The following results had been obtained by him :—

Medical Examination for the detection of Phthisis.

A.—15 clerks, Government office, 5 affected (1 had wife died of it).

B.—43 boys at a Indian School (H)—

Definite phthisis	...	3 (with apices in all).
Suspected ...	...	4
Total	...	7

C.—20 clerks in a Rail office—

Both lungs affected	...	5
One lung ,,	...	2
Suspected ...	...	2
Total	...	9

D.—20 employés in an Indian Printing Press—

Both lungs affected	..	8
One lung ,,	...	9
Suspected	..	1
Total	..	18

E.—32 boys at a well ventilated school (M)—

	Active phthisis ...	2
	Suspected ...	4
	Total ...	6

F.—60 boys at Indian School—

	Definite phthisis ...	4
	Suspected ...	16
	Total ...	20

G.—20 clerks, Rail office—

	Definite phthisis ...	5
	Suspected ...	5
	Total ...	10

——	Definite	...	43 or 25·7 per cent.
210	Suspected	...	32 or 15·4 ,, ,,

Tuberculin Institute or Anti-tuberculin Preventorium, 16th June to 31st December 1913.

1. Total number patients seen —1,096 { 301 Hindu males. 212 ,, females. 462 Mahomedan males. 121 ,, females.

Of these 11 were outsiders.

2. Number actually tubercular = 361 or 33 per cent.
   Of these phthisis ... = 255 or 70·6 ,, ,, of the total.
   Tubercle of glands... = 74
   Other form ... = 32
3. Number of houses visited by the medical officer = 203
4. Number of phthisis death returns enquired into at their houses ... = 152
5. Number of contacts examined at their houses ... = 218
6. Number of houses disinfected = 162
7. Number of leaflets given out = 1,275 (Urdu = 967, Hindi = 308)

In addition to thousands by Sanitary Inspectors.

It must be remembered that tuberculosis is an infectious disease in which the house played an important part, and probably the disease might be regarded as endemic so far as the house is concerned. The house was the danger zone, and wherever there had been a certain amount of opening up of a locality, the incidence of the disease had been tremendously reduced. At the same time, owing to the ignorance of the populace, measures should be taken to educate the people through the means of tuberculosis preventoria.

Dr. Froilano de Mello said:—

Rerise.—Il y a deux causes pour lesquelles la tuberculose augmente. D'abord le *struggle for life* est bien plus grand qu'auparavant.

Secondement l'extension clinique et anatomie pathologique de la tuberculose est bien plus grande et on n'accepté pas comme tuberculoses

seulement la tuberculose pulmonaire, la consumption, comme on faisait au temps de Valleurin et Laennec.

MAJOR SPRAWSON then introduced a paper on "The organisation of anti-tuberculosis measures in India."* The following is a summary :—

"For the purpose of these measures Indian committees are divided according to their means into four classes, and the application of various hygienic measures to each of these are discussed : namely—

1. Notification.
2. Tuberculosis hospitals.
   Relation of the medical officer of health to the tuberculosis hospital.
   Relation of the medical practitioner to the tuberculosis hospital.
3. Travelling exhibitions.
4. Prevention of spitting
5. Inspection of school children and schools.
6. House visiting.
7. Improvement of the milk supply.
8. Improved dwellings and town-planning.

Stress is laid on the inclusion of a course at the tuberculosis hospital in the medical student's career, and on the better housing of the poor."

Major Sprawson said he wished to comment on three points. The first and the most important of all measures against tuberculosis was the provision of better dwellings for the poor, and the driving of better streets through congested areas. He had sometimes seen in Lucknow tuberculosis running through a zenana; the women and children living shut up in a small area, infected one another.

The second point was what he called house to house visiting by nurses. The excellence of such nurses had already been referred to by Dr. Turner and Mr. Moore, and he had seen the nursing work in the tuberculin dispensary in Bombay. The careful selection of a tactful woman was essential and the women had to be paid well. The work could not be entrusted to *dais* who might use their entry as a sort of leverage to extort money on the threat of further measures being taken. The last point he wished to comment on was one on which, speaking for himself, he was still open to conviction. This was as to what should be done in the ordinary Indian household with ordinary spit. The people will spit and they do spit and there is no way of stopping them. The question is where should they expectorate? At present they do so on the floor, and the walls, and in the nullah. They had concluded that it would be best for the people to expectorate in spittoons and empty the contents into the privy to be carried away by the sweeper in the morning. The council of perfection would be to burn it, but they will never do that. He would like to know if anybody had anything better to suggest.

DR. NEWELL :—It is necessary to prevent a misapprehension, to consider the principles underlying the establishment of a tuberculosis preventorium in India, and their method of work to suit our conditions and to see how in practice they differ from the ordinary "dispensary" or from an out-patient "dispensary" of a hospital. We have to recognise the antipathy of Indians to inoculations, and their dislike to enter hospitals except at the last stage. All this at once shows that it cannot be successfully attacked without some organisation so constituted that it can grapple with every aspect of the preventive side of the subject, and follow up its ramifications through the social cosmos. This is what the tuberculosis preventorium is able to do, and what the ordinary dispensary or out-patient dispensary cannot do; the organisation which exists and which can best deal with the preventive aspect is the Health Department. To be entirely successful, true it must have a close association with any other institution

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but the time has not yet come for any very close association other than that of co-operation and drafting cases to hospital. It will be disastrous to divorce tuberculosis preventoriums, instituted for the benefit of the masses, from the control of municipal bodies, and especially so in the early stage of their inception.

The functions of the tuberculosis preventorium so far as Indian conditions are concerned may be summarised as follows :—

1. As the headquarters to disseminate information and advice.
2. To give any aid in the diagnosis of cases, or examine any notified case where desired.
3. To follow up all death returns for the purpose of verifying the truth of the return.
4. To examine any contacts in any house or to detect "early" cases.
5. To act as a "clearing house" for patients so as to draft them either to a medical dispensary, out-patient dispensary of a hospital or to the hospital ward or Sanatorium.
6. To carry out the disinfection of infected houses as notified by the Health Officer.
7. To report housing and sanitary deficiencies met with in the course of home visiting for action by the Health Officer.
8. To give "tuberculin" as a preventive measure to *early* cases and such suitable cases as will not go to hospital by the Tuberculosis Officer.
9. Home visiting by Lady Health Visitors to secure hygienic and dietetic measures.
10. To be a medium through which any charitable or voluntary organisation may give any philanthropic help.
11. To be a centre for the distribution of leaflets, sputa pots, paper handkerchiefs, disinfectants, etc.

Dr. Lankester expressed the strong opinion that tuberculosis is greatly on the increase throughout India, and that a clearer recognition of this fact is of the utmost importance with reference to the problem of preventive measures.

This increase in prevalence mainly affects the lower stratum of the educated classes in the cities, the student and clerk classes, and some of the reasons for this are fairly obvious. But the prevalence is very great also in the villages, and it is a matter of surprise that some of the more vigorous types of village population, such as the Frontier Pathans, are affected to a serious extent. The frequency of tubercle amongst natives of Afghanistan seems to show that there is no definite connection with British occupation. He thought that the fear of arousing prejudice by preventive measures had been exaggerated, although of course there was the greatest need for tactful care in any interference with the habits of the people, yet that the people recognized the evil and were anxious to be helped to combat it. Any such efforts needed to be of a close and personal nature. He gave a warning against any system of notification, followed by personal visitation by a sanitary official, as opening a door to attempts to make threats of notification a means of extortion, thus destroying confidence amongst the people. A better course would be to mark the localities of tuberculosis cases on city maps, and to let streets or quarters showing a large percentage of cases be subjected to house-to-house visitation. Such visitation by nurses or others, if done in a tactful way might be of the greatest value.

He thought that the disease is far too widespread to be dealt with by Sanitoria, as the money spent upon large institutions could be far better spent otherwise. Sanitoria if established should be for *education* rather than treatment, and should be near the centres of population, not in distant hill districts.

Dr. Lankester gave a strongly favourable opinion founded upon personal experience of the value of tuberculin treatment in skilled hands, but gave a strong warning against the present and rapidly increasing indiscriminate use of tuberculin by private practitioners not possessing the requisite knowledge to enable them to choose cases and guard against risk. This danger could only be combated by arranging for free treatment in skilled hands.

Tubercular sputum could most easily be dealt with in cold weather by directing patients to spit into burning charcoal angithis. The whole problem is too big for Government and is one in which there is urgent need for the encouragement of private effort and co-operation.

He insisted upon the importance of establishing a large organization, to form public opinion, arouse private generosity, and call forth voluntary effort on a large scale. He thought that financial aid should be forthcoming for all forms of skilled private effort, whether in establishing tuberculosis dispensaries, in undertaking house visitation, and in other directions so long as they had the approval of the local Sanitary Authority. While money was poured out by Government for education and hostels, it ought to be available for building cheap but sanitary clerks' quarters, for grants of free tuberculin to skilled workers, and the like.

It would be well if some of the money spent upon palatial buildings could be diverted to the less showy but not less necessary work of destroying buildings which are proved breeding-places of disease.

MAJOR MCCARRISON :—I will take as the text of such few remarks as I propose to contribute to this discussion, Majors Cochrane's and Sprawson's axiom : "It is not every physician who should give tuberculin to his patients though they may need it." Koch in one of his earliest papers has assured us that tuberculin has only a slight effect on the healthy organism, that is to say, that it is devoid of danger. In a later paper, however, he modifies this opinion somewhat and admits that tuberculin may have some ill-effect on the healthy subject. Later workers, who have concerned themselves with this aspect of the action of tuberculin, have come to the conclusion that for the healthy individual tuberculin is very harmful. Landmann, for example, has prepared from the tubercle bacillus a substance which he calls "Tuberculol" and which he has found to be a deadly poison ; this has led him to the belief that 'Tuberculin' also is to be regarded in the same light. More recently Paul Geibel has arrived at a like conclusion. There is, therefore, a considerable volume of evidence to show that tuberculin should at least be treated as a "poisonous substance" and its distribution guarded with the same stringency as is applied to other poisons. I am strongly of opinion that it should be issued only to persons holding a registerable medical qualification, and even then the physician should not use the drug unless he is familiar with the methods of its administration.

The skilled immuniser is only just beginning to appreciate the value of the remedy and it is only comparatively recently that he has laid down a system of dosage which can, with safety and advantage, be employed by the physician in suitable cases. I have seen in one case the most unsatisfactory results follow the use of this agent in unskilful hands. It is, therefore, with great interest that I hear of the special training in this department of medicine which is given at this Lucknow College, so that within a few years we may hope to find the ranks of the profession enriched by a number of physicians who, thoroughly conversant with the uses of this therapeutic agent, will be able to employ it with the same advantage to sufferers from tubercle as have the authors of the instructive papers to which we have just listened.

MAJOR C. H. BUCK :—Dr. Lankester has told us that money is being poured forth for education, but it is for that of boys and not of girls. High infantile mortality and all the diseases mentioned this morning are, in my opinion, mostly due to the ignorance of the women of India, and this can only be remedied by a great increase in female education. I should be very sorry to see any decrease in expenditure on this side of education, in fact, I think it should be very greatly increased.

DR. SOUZA read the following note :—I beg to make a few remarks regarding the control of Tuberculosis hospitals. The authors say that they should be in medical charge of the physicians of the Medical College hospital. From what I have seen in Bombay and Calcutta, the physicians are so overworked that I do not think they have sufficient time to devote to the Tuberculosis hospital.

I am not aware that in England, Tuberculosis hospitals are placed in charge of the Medical College; they are, so far as I am aware, under the county councils.

In my opinion the resident medical officer of a Tuberculosis hospital should be a well qualified officer and placed in sole charge of the hospital. He should be under the municipality and work hand in hand with the Health officer. His duties should be not only to treat patients indoor but to advise patients at their houses and to supervise the work of visiting nurses. He should advise the Health Officer as to the special measures he wishes him to carry out.

I consider that these are the functions of a Tuberculosis officer and this being so, his work could never be supervised by the physicians of a Medical College but by municipal officials. Besides, municipal and public bodies are not likely to finance any institutions over which they will have no control.

The students of a Medical College can take a three months' course under the Tuberculosis officer and obtain a certificate from him.

I do not approve of the term Tuberculosis hospital and would replace it by municipal sanatorium. The word tuberculosis carriesa certain amount of dread with it, and should, as far as possible, be avoided.

THE PRESIDENT :—As we have the great benefit to-day of the presence here of Sir Malcolm Morris who founded the National Association for the prevention of consumption, I think we would all be very grateful to him if he would address a few remarks to us on this most interesting discussion.

SIR MALCOLM MORRIS :—Sir Harcourt Butler and Gentlemen,—I am much indebted to you for your kindness in asking me to speak. I am here simply as a mere globe-trotter to see India and to study some of the sanitary problems of this enormous country. So far as the question of tuberculosis is concerned, there seems to be no doubt, from what I have heard and the travels that I have made, that the disease is spreading to a somewhat alarming extent. Why it is spreading more at the present time than formerly I can form no opinion. The task of collecting accurate statistics at the present time to compare with any previous time seems to me practically impossible. We must, therefore, assume on general evidence that the disease is spreading. Now, if I wish to sum up what I think, from my experience of the disease gained at home, I should say that I agree practically with every single word that has been uttered by Dr. Lankester. In the first place, I would most emphatically impress upon the practitioners in this country the importance of the extremely careful use of tuberculin. I look upon tuberculin as a sword with two edges; one side the enormous benefit in certain carefully selected cases, on the other side an instrument of incalculable harm. I cannot imagine any greater danger than putting this weapon into the hands of people who do not understand its exact use. What I am saying now has been said at home most emphatically by a man who has done an enormous amount

of work with tuberculin, that is, Dr. Hector Mackenzie of the Brompton hospital. At the Tuberculosis Conference held in London last August he read a most careful paper upon his experience in the use of this remedy. The sum of that paper is this,—that it is only of use in carefully selected and especially early cases, and that it may do the most infinite harm if it is used in later cases when the structure of the lung has begun to be broken down. If, therefore, this drug is used extensively in a large country like this, I am perfectly certain it is calculated to do more harm than good. The next point that I would make here in this country is this, and that is to put the most emphatic emphasis against the building of large sanatoria. It is in my opinion the greatest possible waste of public or private money to build large institutions for the treatment of tuberculosis. It is necessary rather that we should confine our attention to the actual source from which the disease comes, and that is the condition of the homes of the people. If we can get down to the rock bottom of this disease and teach the people that they are spreading the disease themselves by spitting about their rooms and by keeping advanced cases in their own small habitations, we shall be doing very much more towards stamping out the disease than by building palaces for the cure of a few. I would again, Sir, with your kind permission simply emphasize most strongly the most admirable remarks that have been made by Dr. Lankester. I believe they are the key to the problem in this country. I recognise the fact that the problem here is far more difficult than it is with us. You have a greater difficulty in educating the people. That is the burden of the whole cry so far as this insidious disease is concerned. If you can get down to the people and teach them some of the rules of this disease, some of the methods of preventing the spread of it in their own houses, you will be doing something which is real. That that problem is an enormous one here, no one recognises more than I do, and I think, if I may conclude with one word of encouragement to those who are working throughout this large empire, it is one of emphatic encouragement in the work they are doing. It is bound to tell in time if men go on working as you are working here, you who know, you who understand it, coming from each individual centre, you have got to spread the knowledge among the people who are not so well acquainted as you are. Then by degrees it is likely that the knowledge may spread to the people themselves.

THE PRESIDENT :—I am sure we are all deeply beholden to Sir Malcolm Morris for the weighty words he has addressed to us and which we shall all ponder and act upon.

MAJOR SPRAWSON then introduced a second paper by himself and Major Cochrane on "Experience in treatment of pulmonary tuberculosis in Indians by tuberculin."* The following is a summary .—

"There is but little truth, if any, in the belief that natives of India offer less resistance to the ravages of the tubercle bacillus than natives of other climes, but that given early diagnosis and suitable treatment the prognosis is favourable. The result of treatment by tuberculin over a period of three months in 108 cases of pulmonary disease in all stages, shows a percentage of over 40 per cent. arrested disease, and a further 31·5 per cent. much improved. In 53 of these cases tuberculin was practically the only treatment adopted and they were treated at an out-patient clinic.

The experience of the authors is that tuberculin, which requires a close study, is of much value and can be used with success in out-patient practice, even in febrile patients, by an experienced practitioner exercising due care."

Major Sprawson emphasised the misuse of tuberculin by unqualified practitioners. He thought the cure for this was to educate all

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practitioners in the proper use of it. This they were doing in the medical school at Lucknow, where each student would go through a special tuberculosis course and be educated in the method of the use of tuberculin. Neither Major Cochrane nor he considered that tuberculin had by any means reached finality in the treatment of tuberculosis. He thought Dr. Lankester's suggestion with regard to the disposal of sputum was a good one. It would work well in the cold weather when people could spit in their *anghitis*, but in the hot weather the spittoon was the only receptacle he could think of. He thought that the medical officer of health or any of his subordinates should not be in independent charge of a tuberculosis hospital. This was a mistake as experience in Britain and out here had shown. Another reason was that a physician is regarded by the people as a beneficent person, and any measure introduced by him was much more likely to prove popular than when introduced by a sanitarian.

Major Gloster then introduced his paper on a "Preliminary enquiry into the prevalence of tuberculosis amongst Bombay cattle."*

The examination of slaughtered cattle at Bandra by veterinary inspectors during a period of several years did not reveal the presence of tuberculosis.

An examination of 101 samples of milk, 99 from single cows, was carried out at Parel, but in no instance were tubercle bacilli found by microscopic or animal tests.

Although it is not permissible to make any definite statement as the result of the examination of such a small number of samples, all the evidence goes to show that tuberculosis is not common among Bombay cows.

The author had inspected and examined carcasses of cattle at the Bandra slaughter-house without discovering any evidence of tuberculosis.

Examination of milk samples for the tubercle bacillus were also negative.

Dr. U. N. Brahmachari described his experience in the treatment of tuberculous cases by tuberculin. In 1913 he had treated over 100 cases in the Campbell Hospital, they were mostly pulmonary in type, with tubercle bacilli in the sputum. Out of 60 cases in hospital, 30 died, 4 showed marked improvement, in 2 the rise in temperature was much diminished, the remaining cases passed from bad to worse and either died or left the hospital without improvement.

He regarded the results of treatment of his hospital cases as unsatisfactory. In private practice, where milder cases were more frequent, his impression was that benefit resulted. Every physician should learn the technique of tuberculin treatment.

He agreed with Sahli that, while tuberculin would do no harm if carefully administered, no cure could be guaranteed. It was a valuable remedy, but its action depended essentially upon the way it was used and the extent to which it was tolerated.

He considered that tuberculin treatment to be successful should be carried out under the best hygienic surroundings, such as can be obtained in health resorts.

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SECTION B.

First Session.

The Hon'ble Mr. L. C. Porter, c.i.e., i.c.s., Presiding.

(*a*) *Water Supply and drainage bye-laws.*

Major L. W. S. Oldham, r.e., introduced his paper "Notes on Assessment of Water Rates."*

"These notes are the result of the study of the numerous diverse sets of rules in force in different municipalities, for the assessment of water rates.

The tabular statements were prepared for information, and in order that a clear comparison might be made of the actual rates paid by similar classes of the community in different towns under different rules.

It is hoped in this way, by drawing the attention of municipalities to anomalies, and to cases of inadequate taxation, to obtain a revision of the rules, and to make them less complicated and cumbersome, and at the same time more efficient.

The notes will also, it is hoped, be of assistance in the case of towns for which water-supplies are proposed, and where rules for assessment of rates are under consideration by the municipal committees."

Major Oldham said :—"I am afraid this subject is of very little interest except to persons engaged in the financial consideration of water-works. It is the financial side, however, that usually presents most obstacles, whether it is a question of new water-supplies or the expansion of existing systems. The plea of poverty and want of funds is very apt to be raised when water-works schemes really present sound investments for municipalities. It was in order to ascertain and compare what are the rates actually paid for water by the consumer in towns in the Central Provinces, where there are pipe supplies, that these figures were got out. The statements opposite pages 4 and 5 of the notes show that the rates are very low, and in the case of private connections in many cases quite incommensurate with the benefits enjoyed. Another object in view in collecting the data contained in these notes was to help in formulating a set of model rules and bye-laws for new water-works, and also in the matter of revising the existing bye-laws both for the assessment of rates and for the general administration of the supply. Since I wrote the note I have collected some information about the cost of water-supply in places where there are no pipe supplies, and found that the actual cost to individuals is incomparably higher in most cases where there is not a water-supply; and the rates paid are often immense compared with the rates paid for private house water connections. For instance, people with gardens have to keep water carts and bullocks, and this costs about Rs. 25 or 30 a month, and people on small incomes—clerks on Rs. 80 or Rs. 100—pay at least several rupees a month for water brought to their houses, whereas with us in the C. P. the minimum water rates for pipes inside the houses is as low as 8 annas a month."

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Mr. J. W. Madeley next introduced his paper, "Notes on water-works and drainage bye-laws."* The following is a summary :—

Water and drainage works are now being carried out by a very large number of communities in India, and in order to ensure uniformity of practice in sanitary matters, a Public Health Act on the lines of the English Public Health Act would be of great value.

Any such Act should be sufficiently general to allow of local variation of conditions. Standardisation of bye-laws based on the Act is also desirable.

In Madras city, the improved water-supply and drainage systems have practically amounted to new systems, and for their efficient control and working new clauses in the existing Municipal Act, as also new bye-laws, have been drafted.

The writer gives a list of points dealt with in the new clauses proposed for the Madras City Municipal Act upon which the proposed bye-laws for control of the water and drainage schemes are based.

He said :—" This subject of bye-laws for water and drainage works was one that was specially recommended for consideration by the Engineering section at the last Conference, and that accounts for the paper having been written. It has been my duty to prepare these designs and supervise the construction of water and drainage works for the city of Madras, and to ensure that these systems will be properly worked, it has been necessary to draw up bye-laws regulating them. It was found that bye-laws could not be put into operation until the Municipal Act was modified. Therefore it has also been my business to prepare draft water-works and drainage clauses for the new Act which will be introduced into Madras before long. In the course of this work it has been very strongly impressed upon me that model water-works and drainage clauses would be of extreme use. In my own case, in order to prepare the clauses for the Act, I had to study all the existing Acts that were available, and to adapt them for Madras, with such modifications as were necessary and such additional clauses as seemed desirable. After the proposed clauses have been passed by the Corporation they have to go to high legal authority to see if they are in order. I expect all of us know of cases where municipalities have found that they had not the powers that they thought they had. The Madras Government has been in court over the Ootacamund drainage. Colombo has found that it cannot enforce house connection, and has to amend its ordinance, and in Madras City we do not know where we stand with reference to house connections. We have laid the sewers, but the Act seemed a little doubtful and the matter was referred to two legal authorities—one said we had the power, the other said we had not. Now the only thing to do is to have a test case and fight it out. But if we had some standard clauses drawn up by the best men available in India, these clauses might be adopted wholly, or as considered desirable, by municipalities, and we should know exactly where we stood. Such clauses would ensure uniformity in practice which is highly desirable, and we should also know exactly the legal position. And it would only be proposed variations which would have to be considered. I know in my case, that if we had these standard clauses to go on, and if we had these model bye-laws as a basis, it would have very much reduced my work. No doubt Mr. Hutton, the Sanitary Engineer to Government, and other Government officers concerned would be able to say that their work also would have been very greatly reduced.

The same remarks that apply to the standard clauses of the Act also apply to bye-laws. It is very important that sanitary work should be standardised as far as local conditions permit. At present, we are carrying out a very large number of water and drainage works

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in India, and it seems to be highly desirable that these standard clauses and rules should be decided on and fixed before these new works come into operation. In England difficulties arising from differences in the rules of sanitary authorities have caused committees to be formed to standardise practice. On these committees all interested parties are represented. They have drawn up standard rules and regulations and it seems to me that some such procedure might with advantage be adopted in India. I may instance house services for water supply. The question of the restriction of waste is one to which everyone connected with water-works engineering has had to give a great deal of thought. And the question of what pipes might, for instance, be allowed, is in Madras a very important one. I have found a great deal of waste from house service connection and found that due in a large measure to a poor class of pipes. I found that the merchants in Madras had considerable stocks of these poorer classes of pipes. In the rules that I have proposed, I have specified the class of pipes that may be allowed to be used, and one trouble that I foresaw was getting rid of this stock, but was informed that they would be sent up-country. I think that the up-country municipalities would be better without these poor pipes. They may be low in first cost, but they will be very dear in the end. And the same applies to India as a whole. It is commonly stated that merchants at home ship their rejected wares to India to be sold in the bazaars. If we have standard rules, and if we keep a list of contractors who should be allowed to supply materials, I think that we could keep the poor stock out of India to a great extent. Then there is another question to which a great deal of thought must be given by engineers and sanitary officers and that is the question of drainage house connections. This is a matter that we have dealt with in the bye-laws and in the Act itself, and it seems a pity that the great amount of thought that has been given by individuals to this subject cannot be made available for general use. It should be easy to prepare standard rules and standard clauses from the result of the accumulated experience that we now have, which experience is sufficient to enable us to draw up rules to meet most cases. Therefore, gentlemen, I purpose that one of the resolutions which should be put forward by the Engineering section of this Conference should be a resolution recommending that the Government of India appoint a committee to draft water-works and drainage clauses, and also a model set of water supply and drainage bye-laws. This might be adopted wholly or with modifications to suit any particular municipality, just as in England a municipality often incorporates in its Water-works Act the provisions of the Water-works Clauses Act, and as the municipality adopts the Local Government Board's model bye-laws with such modifications as they consider necessary. At the end of the paper I have given a list of the points that I myself have dealt with in the Act and bye-laws. It is rather difficult for an engineer like myself to decide exactly what should be included in the Act and what should be included in the bye-laws. In a general way I have arranged that the Act describes what *shall* be done and the bye-laws the *way* in which it shall be done, the bye-laws being more or less in the nature of specifications. And for Madras I have proposed the President or the Standing Committee of the Corporation as the deciding authority in the case of the Act, and generally speaking the engineer the deciding authority in the case of the bye-laws."

MAJOR H. C. BEADON, I.A. :—"I should like to ask Major Oldham one question in connection with his taxation. I am rather surprised to see that water rates are assessed on the somewhat varying rentals of houses. It seems to me that when we supply water, we supply it not only for sanitary purposes ; the municipality

should also consider the financial position; it should make people pay by quantity. Of course, we have the custom of metered supply, but I always understood that the usual custom was to supply houses by a flat rate according to the size of ferrules. I may mention that this is how we do it in Delhi, and in addition to assessing by the size of the ferrule, we also put a small tax fixed according to the number of taps supplied to each house. I would like to ask whether it is general in other parts of India for water rates to be assessed on the rentals of houses. Of course, I quite recognise that poor people must get a certain amount of water free, but that is always supplied at the public hydrant."

Rai Sahib Wazir Singh:—"You will find that the first thing which we have to do in the case of water-works is to find out the principle of assessment. In the paper by Major Oldham I find that four principles are inculcated; one of which is the general water rate; secondly, the private water rate; thirdly, according to rental value; fourthly, per capita. I would submit for your consideration that you will find that in all these principles there are some difficulties. In the case of rental value, so far as the property is in the occupation of the tenant we can usually find it out; but when the property is in the possession of the owner himself there are various questions which arise in order to determine the rental value, and it is in the case of the house tax that such difficulties usually arise. Therefore, I submit that this is not a sound principle upon which the water tax should be assessed. Then you will find that in India the value of property nearly in every big town increases daily, and so there would be frequent changes in the rental value and consequent changes in the water rate. The second principle is per capita. On account of deaths and births which are bound to occur in one's family this system is also liable to fluctuations and so it should not be adopted. The third is according to a general rate. A general rate no doubt may be levied so far as the construction of the plant is concerned. But after the water-works have been constructed then we have to see how to supply that water. Strictly speaking, it is not a tax at all. It is, as a matter of fact, an equivalent charge for the water-supply to a consumer. It is the duty of every municipality to supply pure water to the persons in their charge, and, so far as the poorer classes are concerned, this should be done absolutely free by making public standposts in bazars and streets. Those persons who do not want to take the trouble of going to the public places, and want to have a private connection of their own, should pay according to measurement, which is, I submit, the only just and equitable mode of assessment. The domestic purposes for which the water can be used must also be defined, and we have got that definition under the Delhi municipal rules as well. Otherwise we find that big persons will use a very large quantity of water and pay a very small rate. Therefore, it is desirable that the domestic purposes for which filtered water can be used must be defined in the rules of the municipality. It is not also clear from the pamphlet who would bear the charges of connection. If a general rate is fixed, will the committee take upon itself the charges of connection. I submit that the safest course is that the consumer who applies must pay for the connection. As regards the number of taps, I may simply remark that the committee does not suffer in any way because the water which comes out of the ferrule is of the same quantity, regardless of the fact whether there are one or two or three taps, whether these are on the first, second, or the third storey. We have only to judge of the quantity of water which comes out of a ferrule of a particular size. But all the same, for convenience sake in Delhi we allow three taps or two taps at present. The same rate according to measurement also prevails in Lahore, and Amritsar. So far as the Punjab is concerned, I submit that this principle of

assessment on measurement has been adopted and there is no reason why it should be otherwise in other places."

Mr. G. P. Robertson.—"I should like to point out that so-called 'free water' must be paid for by somebody. It cannot be absolutely free. In Darjeeling the water is paid for on the house rate, and so far as I remember it works out to about 6 annas per thousand gallons. The size of the ferrule does not restrict the quantity of water; if you put on more taps you get more water. Not only that, but in places like Darjeeling the pressure varies enormously from anything up to about 200 pounds per square inch, and when the pressure rises the quantity of water through the ferrule increases enormously. I should like to ask about one point. In Darjeeling I could never burst a half-inch pipe under a pressure of 500 pounds per square inch."

Mr. Madeley.—"I find Major Oldham's paper of very great interest and I can confirm many of the conclusions at which he has arrived, and perhaps we have adopted much of the practice that he recommends. In one part of his paper he says: 'Another point in connection with private connections is that the number of taps allowed should be limited in proportion to the water-rate paid. For the minimum rate one tap only should be given, and a rule should be strictly enforced by which this tap is fixed in full view from a public road. Such a rule would facilitate inspection and the check of leaky fittings and other causes of waste.' I think this is a most important provision and is one that I recommended for Madras, and which the Madras Corporation has accepted. In Madras, caste people have raised objection to our going into their houses, and if we allow taps without meters in places where they cannot be inspected, there will always be a great deal of waste. I therefore propose that we should allow one tap fixed in full view from a public road in order that unmetered supplies can be inspected. In the case of house-owners requiring a better class of supply a meter is fixed, and they can have taps placed inside the house at points which the President or Engineer considers necessary—of course in reason only. Major Oldham says: 'It is evident that anything like the universal measuring of private supplies on an Indian water-works is impossible.' While that is the conclusion I have come to in Madras on account of the large expense of the meters and the cost of upkeep, possibly there are some other reasons which Major Oldham has found. If so, I hope he will be able to tell us what they are. Then in section 5 under the model rules—'no pipe larger than three-quarter inch diameter will be used.' Well, in Madras, we are proposing a half-inch diameter. We have at present got pipes one and-a-half inches in diameter, and sometimes even two inches, but we are going to reduce them with an increased pressure to half-an inch in most cases. I think it is a fallacy to say that the quantity of water going through a connection depends on the size of the ferrule. For instance, if you have a dozen taps leaking at an equal rate, you would get a greater leakage than with one. Additional taps most undoubtedly lead to greater waste. That is the result of experience. With reference to charging for water on the rental of the house, I have always found that it has worked very well. As to the charge for meters, we are charging rupee one per mensem for all meters, except in special cases. Major Oldham gives meters right up to 7 inches. Those will be special cases and there will be special agreements in those cases."

Mr. G. W. Disney.—"In what was known as the Lower Provinces including Bihar and Orissa, Bengal, and Assam, the practice has hitherto obtained of allowing practically unlimited unmetered house connections, these being frequently placed in the zenana quarters and consequently immune from surprise visits by Water Waste Inspectors; the payment for the services, a water-rate, the maximum

of which, under the Bengal Municipal Act governing this area, is $7\frac{1}{2}$ per cent. on the value of the holding. This water-rate is found, in the majority of cases, not to have been imposed up to the full maximum, a low enough one in all conscience, the consequence being that the good to the majority is sacrificed for the benefit of the few, and that the water-supply is not worked on a commercial basis. A copy of a note, and of tables of calculations for existing Water-Works in Bengal, prepared for my Government, is here for perusal.*

In my opinion the wastage of water generally prevailing is largely due to the intermittent system of supply. To obviate the inconvenience of this, house-holders, where house connections are provided, construct reservoirs or other receptacles to store the water in for use during the hours the supply is unavailable, and run this to waste next morning when the supply is resumed. I propose trying a constant supply during 24 hours combined with the metering of all house connections, and the rigid inspection of the meters and taps, and am convinced that, if this can be introduced from the first start off of a water-supply, wastage will be decreased to a minimum. We all know the difficulty of contending against "dustur-ki-muafik," and if the necessity for storing water ceases, the provision for this will not arise, and the *dustur* of storage will not become established. House connections are a luxury, and as such a higher water-rate should be charged than the maximum admissible for a street supply through standposts.

It is of supreme importance to put the financing of water-works on a commercial basis from their inception. This has not, as far as my experience in India goes, been done. I may add that by a commercial basis I mean providing for working expenses and depreciation of plant, and not necessarily a profit-making concern."

* Note on the Financing of Water-Works.

Assuming the cost of water-works for a typical municipality, containing 30,000 inhabitants, to be at Rs. 10 per head (the average capital cost of 5 major Water-Works in Bengal, and Bihar and Orissa works out to Rs 11-4-0), a capital of Rs 3,00,000 would be necessary. (There are 11 head-quarters of Divisions and Districts out of 21 in this Province where the population exceeds 30,000).

On the assumption that $\frac{1}{3}$rd of the capital cost be borrowed at 4 per cent., repayable in 20 years, the annual provision for this amounts to Rs. 7,358, say Rs. 7,400, and if on the basis of a loan on a quarter of the cost, to Rs. 5,550.

Assuming the sale value of water to be at the rate of 3,000 gallons per rupee, not allowing for wastage, the annual income derivable from its sale should be Rs. 36,500, but this is a counsel of perfection, allowing 50 per cent, the annual income would be Rs. 18,250.

Assuming the cost of maintenance to be Rs. 12,000, the charges to be met would be $7,400 + 12,000 = 19,400$ or Rs. 1,150 above the income if $\frac{1}{3}$rd the capital be borrowed, and $5,550 + 12,000 = 17,550$ or Rs. 700 below if $\frac{1}{4}$th.

In the Madras Presidency when mofussil water-works were being initiated in 1891, the Local Government made grants varying from $\frac{1}{2}$ to $\frac{3}{4}$ of the cost of the projects and lent the balance at 4 per cent. repayable in 30 years. In Bombay the present custom is to make a grant of $\frac{1}{2}$ and to lend $\frac{1}{2}$ the capital. In that Presidency it is now found that the receipts from water-rates do not meet the cost of maintenance and of repayment of loan.

The sale value of 3,000 gallons for the rupee is about equivalent to the maximum water-rate of $7\frac{1}{2}$ per cent. admissible in Bengal. In Bombay 10 per cent. is the limit and 8 per cent. is common. In England 33 per cent.

In order to encourage the more rapid extension of water-works, unless it be considered advisable to raise the limit of taxation, it would appear desirable that the Government grant for the construction of water-works be raised to ½ and that the remainder be made up from local subscriptions and funds and by a loan not exceeding ¼ of the capital.

Profit and Loss statement on actual figures for Water-Works in Bengal.

Serial No.	Name of Municipalities.	Amount of capital cost up to 31-3-1912.	How cost was met.			Income for 1912-13 from water-rates.	Annual cost of repayment of loan.	Cost of maintenance, 1912.	Depreciation on Capital cost exclusive of loan at 5 %.	Total recurring charges.	Profit or loss.
			Government grant.	Government loan.	Local resources.						
1	2	3	4	5	6	7	8	9	10	11	12
1	Barisal ...	1,60,000	60,000	35,000	65,000	18,000	2,575	2,575	6,250	11,400	+6,600
2	Berhampur ...	2,91,654	...	...	2,91,654	20,838	...	16,938	14,582	31,520	—10,682
3	Burdwan ...	3,44,162	50,000	1,24,500	1,69,662	28,603	9,161	18,228	10,983	38,372	—9,769
4	Dacca ...	8,84,461	3,95,350	3,25,000	1,64,111	55,242	23,914	25,599	27,973	77,486	—22,244
5	Mymensingh ...	2,51,083	30,000	40,500	1,80,583	23,293	2,980	11,951	10,529	25,460	—2,167
6	Narainganj ...	2,22,900	33,500	1,75,000	14,400	28,274	12,876	9,881	2,395	25,152	+3,122
7	Khulna* ...	31,154	11,000	13,000	7,154	...	956	1,159	908	...	*...
8	Chandpur* ...	27,621	8,180	15,000	4,441	..	1,103	...	631	...	...

* No water-rate has as yet been imposed.

Profit and Loss statement on the proportionate division of Capital of ½ grant by Government, ¼ Loan, and ¼ Local contributions applied to the Water-Works in Bengal.

Serial No.	Name of Municipalities.	Amount of Capital cost up to 31-3-1912.	How cost is proposed to be allotted.			Income for 1912-13 from water-rates.	Annual cost of repayment of loan.	Cost of maintenance, 1912.	Depreciation of capital cost exclusive of loan at 5%	Total recurring charges.	Profit or loss.
			Government grant.	Government loan.	Local resources.						
1	2	3	4	5	6	7	8	9	10	11	12
1	Barisal ...	1,60,000	80,000	40,000	40,000	18,000	2,913	2,575	6,000	11,518	+6,482
2	Berhampur ...	2,91,654	1,45,827	72,913	72,913	20,838	5,365	16,938	10,937	33,240	—12,402
3	Burdwan ...	3,44,162	1,72,081	86,040	86,040	28,603	6,330	18,228	12,906	37,464	—8,861
4	Dacca ..	8,84,461	4,42,230	2,21,115	2,21,115	55,242	16,270	25,599	33,167	75,036	—19,794
5	Mymensingh ..	2,51,083	1,25,542	62,771	62,771	23,293	4,618	11,951	9,416	25,985	—2,692
6	Narainganj ...	2,22,900	1,11,450	55,725	55,725	28,274	4,100	9,881	8,358	22,339	+5,935
7	Khulna* ...	31,154	15,577	7,788	7,788	...	573	1,159	1,168	...	...
8	Chandpur* ...	27,621	13,810	6,905	6,905	...	508	...	1,035	...	...

* No water-rate has as yet been imposed.

Mr. E. G. Turner.—"I have just returned from Europe where I have visited several municipalities in England and in Scotland, and one of the points on which I made inquiries was this question of the water-supply rates. I find that the conclusions arrived at by Major Oldham are practically the same as are in force in England. That it is the exception for anybody to have a meter, and that the general method is to charge so much per cent on the annual rental value of the premises, and the amount charged varies generally

from about 5 to 8 per cent. Factories and places where a large amount of water is consumed, have meters and they are charged always subject to the minimum payment of what they would be liable to under the ordinary rates at so much per cent. of their rental value. I think that perhaps this information might be interesting as confirming the conclusions to which Major Oldham has arrived in his paper."

MAJOR OLDHAM replied:—Major Beadon asked why rental value should be taken as a basis of assessment instead of any other basis. My statements deal only with the existing practice in the C. P.; but I am not sure that assessment on rental value is not as good a method as any other basis of assessment. Major Beadon says that in Delhi they assess on ferrules. That, in some cases, is no doubt a very suitable method of assessment; but it is not of universal applicability. As Mr. Madeley pointed out, where the head varies a great deal, the supply will vary enormously through the same sized ferrule in different places, so that I do not think that that can be taken as being of universal applicability as a basis of assessment of water-rates.

MR. MADELEY.—About the question of pressure of a half-inch pipe being able to withstand the pressure of 500 pounds to the square inch, it is not a question of the strength of the pipe—it is a question of corrosion. You must have a properly protected pipe. Here I am not going into the details of the bye-laws, but my bye-laws specify how the pipes should be properly protected. The weight per lineal foot of each size is also given. That is a question that I had not time to go into in the short note.

MR. T. SALKIELD.—We are under a great obligation to Major Oldham for the valuable information he has got together for us. The point was raised just now as to the commercial basis of water-works. I think all of us who have had any experience of Indian water-works know that the commercial basis is practically an impossibility. If municipalities in India were commercial concerns they would certainly be bankrupt in a very short time. With regard to the question of taps and ferrules raised by Rai Sahib Wazir Singh, I think he has gone a little bit off the lines there. Some time ago I was inspecting a house during the hot weather and discovered that the occupier had very carefully removed every tap from his house, the idea being to keep the premises cool. As the connection was not metered I think that a very strong reason why there should be a limit to the number of taps in any of these private unmetered water connections.

(b) *The improvement of water-supply in municipalities and villages.*

MR. DISNEY introduced his paper on "Water-supplies for small communities and municipalities"* in which he describes eight water-supplies. The first two schemes referred to are for unfiltered water-supplies pumped up by hand power from a well, and from a conserved tank, respectively, and distributed from a raised reservoir by gravity. The next two are for water filtered through Jewell Pressure Filters. In the last four, Jewell Gravity Filters are produced, the source of supply for two being tanks, and for the other two rivers. The designs all vary in character, as described in the text, to suit the local conditions.

MR. A. S. MONTGOMERY.—I think Mr. Disney says somewhere in his paper—it is at the bottom of page 1—that the drawings would be shown at the Conference. I think it would be much easier to understand if we could see these drawings. They may possibly be ready.

MR. DISNEY: They are here.

MR. MONTGOMERY.—There is one other small point. I notice in almost every case of water-supply Mr. Disney has used Jewell filters. I am very interested in the question of Jewell filters. We have lately put up one for the Simla water-supply, and unfortunately although it

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has passed the makers' guarantee with flying colours, we have not yet succeeded, owing to various delays, in getting it passed by the health authorities. That is to say, it has not passed the bacteriological test. I should like to ask Mr. Disney whether in these numerous cases where he has employed Jewell filters he has been successful in getting the filtered water passed by the Sanitary Commissioner or the health officer of the district concerned.

Mr. Robertson.—We had a Jewell filter under test in Darjeeling for a few months. It was no use at all. The water came out exactly in the same condition as that in which it went in.

Mr. H. A. Gubbay.—In order to render Mr. Disney's interesting and valuable paper of use in determining approximately the capital cost of plant, etc., for small water-supplies, the basis of comparison should not be as indicated in the paper, the cost per head of population supplied.

As it is, the minimum cost per head supplied is given at Rs. 8-5 per head at Naraingunge, as against a maximum of Rs. 36-6 at Hazaribagh. This variation is due to the difference in the quantities allowed per head (11·7 gallons against 25 gallons), and in a lesser extent to the head to be pumped against.

The capital cost for plant, etc., reduced to cost per 1,000 gallons per foot of lift works out as follows:—

	Gallons per day.	Population served.	Gallons provided per head, per day.	Capital cost per head.	Capital cost per 1,000 gallons, lifted 1-foot.
1. Supply from well	1,000	100	10	27	.....
2. ,, ,, tank	3,000	1,000	3	4 4	... ..
3. Hinoo water-supply	12,000	750	16	27·4	11·1
4. Chandpur	25,000	3,000	8	8·4	18·6
5. Jorhat	40,000	5,000	8	14·25	12·3
6. Hazaribagh Jail and Reformatory	55,000	2,200	25	36·4	11·0
7. Silchar	101,500	10,000	10	12	10·8
8. Narainganj	230,000	26,000	11·7	8·3	6·7

Mr. Madeley.—I have abstracted the costs very much in the same way as the last speaker, except that I simply take the cost per thousand gallons delivered per day. But as the two methods give very similar results, I think they might be taken in comparison. The lowest is No. 8, which gives Rs. 889 and the highest is No. 1, which is Rs. 2,700, but no other is more than Rs. 1,700, so that the highest cost is not more than twice the cost of the lowest, so that you get a certain amount of accuracy in estimates of water-supplies by these methods. Of course, for an accurate estimate you would have to take the pumps separately, and the filtering plant separately. I should like to ask what the cost of delivery includes. The cost of delivery is given in the paper for No. 2 as 2 annas 6 pies per thousand gallons. No. 3 is given as Re. 1-1 per thousand gallons, and No. 4 Re. 1-4. I should like to know what these include.

Mr. Disney.—Mr. Montgomery asked me what experience I had with Jewell filters. I had a battery of five large ones in Dacca. They were gravity filters—the results were excellent, the water being always passed as very good. At Narainganj my experiments have been equally successful. As regards the cost of distribution, that merely means working expenses such as coal and the fireman's wages. In No. 8 there is a misprint, the cost of delivery should be Re. 1-4 per thousand gallons. In No. 3 the cost of delivery is Re. 1-1 per thousand gallons, which is correct.

MR. SALKIELD—With regard to the question raised by Mr. Montgomery as to Jewell filters, in Delhi we have a Jewell filter working and the results have always been satisfactory. But on this question of mechanical filters, some of you may possibly have read the results of experiments carried out in America. Those experiments decided very definitely that mechanical filters were not always quite satisfactory bacteriologically.

A paper on "A new module"* by Mr. C. F. Wilkins was taken as read.

(c) *Tube Wells.*

DIWAN AMARNATH NANDA then introduced his paper on the "Water-supply for the city and civil station of Sialkot."*

"My chief object in presenting this paper is to attempt to bring into prominence the interesting question of tube wells forming sources of public water-supplies, as we in the Punjab have actually launched into responsibility in respect of our faith about the great future that the problem of tube well supplies has before it, particularly in connection with water-supplies for urban population if not for agricultural purposes. I think this is the most suitable occasion on which we may compare our notes based on experiences already gained, with expert representatives who have come to attend this Conference from the various parts of India.

The official history of the question of tube wells in the Punjab is of very recent origin. It was in 1909 that a tube well was sunk in Lahore by way of an experiment; this consisted of 40 feet of 4½ inches diameter W. I. pipe perforated with holes—like the ordinary Abyssinian tube. The total area of the holes amounted to 14·1 square feet in the 40 feet length of tube or 30 per cent. of the surface of the strainer. This tube was wound with a spiral of brass wire ⅛ inch diameter and over this wire fine brass gauze 40 meshes per lineal inch was wrapped. The tube under a head of 7ft. discharged 3,000 gallons per hour or 8 cubic feet per minute, and as sand was found to have accumulated in the tube and the tests of discharges were of short duration, the experiment did not prove much of a success.

Later on Brownlie's convoluted tube came into notice when the question of augmenting the supply obtained from percolation wells in Amritsar came to the front, also at this time Mr. Brownlie published his notes on tube wells. On the other hand, Mr. Ashford in this interval was probably busy developing his tube in connection with the question of tackling the serious amount of water-logging which is a marked feature of the surroundings of Amritsar. It was, however, in the latter part of 1912 that both the tubes, *i.e.*, that of Mr. Ashford and of Mr. Brownlie having been brought to the notice of the Sanitary Engineer, Punjab, he decided to make a test of their relative merits in identical conditions of sub-soil, and as the water-supply project for the new town of Dera Ghazi Khan was at this time under consideration, those two tubes—both of 5″ diameter—were sunk at the above place. The results of the tests made in regard to the comparative yields obtained from these tubes are given in detail in my note. In fairness to Mr. Brownlie, it may, however, be pointed out that his 5″ tube installed at Dera Ghazi Khan is said to have got a gauze strainer round it instead of the wire strainer, and therefore the unfavourable results obtained so far in that place cannot be said to have any finality in them so far as the good point of Mr. Brownlie's tube—covered by its own special strainer—are concerned. I have been able to bring samples of both the tubes for the inspection of those delegates who may be interested in this question.

I may mention that Mr. Brownlie's tube is manufactured by the Empire Engineering Co., Cawnpore, while Mr. Ashford turns out

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his tube in the Central Canal workshops at Amritsar, and his agent are R. L. Cooper & Co., Lahore."

MR. MONTGOMERY.—"As I am practically responsible for the design and carrying out of the Sialkot water-works, I should like to elaborate somewhat what my Personal Assistant, Diwan Amarnath Nanda, has said about the comparative merits of these two tubes. I think I might preface my remarks by saying that you must not look on tube wells as a panacea for all the difficulties which we have to encounter in supplying water to the small towns in the Punjab. They are only suitable in very special conditions of sub-soil. The special conditions which I lay stress upon, as suitable, are, that the sub-soil stratum into which the strainer of the tubes is sunk should be of considerable depth, say 30 to 40 feet thick, and that it should be at a reasonable depth below the surface, say 70 to 80 feet, and that the sand should be more or less uniform in texture. The sand should be coarse, clean, unmixed with nodules of clay, and so forth, which would be liable to clog its tubes. And so it may be said that these tube wells are not suitable for all conditions, as I gather a lot of people think they are. Then as regards the comparative merits of these two tubes, there are one or two things I should like to point out which are not touched on in the paper.

I may start off by saying that the Dera Ghazi Khan experiments were conducted absolutely fairly as a comparative test between the two tubes. The two tubes were put down about 100 feet below ground surface with equal lengths of suction, the pumping plant and strata in which the tubes were sunk were identical. When Mr. Brownlie sent down his tube to Dera Ghazi Khan, there was very great difficulty in getting delivery in India of the straining material which is used round it. This straining material is, I believe, made by the Glenfield Company in Glasgow. They could not give delivery of it. We had to get our supply somehow, so Mr. Brownlie said, "never mind, I will put wire gauze round the tube and I will guarantee that it will last for a reasonable time," and so we put them down. I pointed out at the time that he must be perfectly willing to abide by putting these down alongside the *pucca* Ashford tubes, and he agreed. Mr. Brownlie was prefectly aware all the time that his tube was going to be tested against the Ashford tube.

In Diwan Amarnath Nanda's paper he gives the present conditions of the test. I may say that we have now final tests which show that the Brownlie tube is now discharging 40 gallons in a minute, and that three feet of sand has collected in the tube. The Ashford tube test now gives 170 gallons a minute and it has 3 inches of sand in it. When Mr. Brownlie heard that his tube was not giving good results, he got very anxious about it and came to me and asked me to point out to the Conference the fact that his tube was not covered by the genuine straining material, and I said that in all fairness to him I would point out that his tube at Dera Ghazi Khan is not covered with the straining material as shown here. The Empire Engineering Company are going to supply a new tube at Dera Ghazi Khan and later on we will be able to see why the original one has failed.

Then one of the arguments which is laid down in favour of the "Ashford" tube is that it can be worked to an unlimited head of pumping and that for the "Brownlie" tube the pumping head against the tube is limited to 7 feet.

The reasons that are stated here are the respective statements of the patentees—I may say the rival patentees—and these are simply their bald statements. Personally I think Mr. Ashford's statement that an unlimited head is permissible against his tube is all wrong. I think it stands to reason that most tubes of this construction, or any tube at all when drawn on with an excessive head would allow

fine sand to be drawn up and drawn through the tube at a tremendous rate. This would come up into the pumping apparatus and score the pump plungers and valves. And if they do not do that, then you get finer particles and silt packed up against the tube, and the result will be to reduce your yield. I think Mr. Brownlie's statement that a 7 feet head is the limit against which his tube can be worked is more or less correct, and I believe he has gone into the theory of his very much more than Mr. Ashford has. At the same time at Sialkot, in order to be on the safe side and to satisfy both parties, I have made arrangements to increase the pumping heads against these tubes to about 12 feet, and we shall see what the result is, whether they can stand it or not. Personally, I think they will stand it.

This tube which I now will show you is an "Ashford" tube and is a small one of about 4 inches diameter. Now for larger tubes of say 10 inches diameter, this is not the form of construction at all. It is a much prettier construction. Mr. Ashford takes 8 square rods about $\frac{3}{4}$ of an inch, or an inch in diameter, and sets them in the form of an octagon like this (illustrates). He then puts cast-iron segments inside, to keep them apart and to keep them from being crushed, and then he takes this framework of rods (and I think he puts a wooden core inside to support them), and he puts the whole thing into a lathe and turns the rods very slowly, and in the meantime pays out copper-wire through a mandril, round it. This copper wire which comes through the mandril starts by being round, and ends up by being a trapezoid. Mr. Ashford can wind this wire so as to get the slots as fine as a thousandth part of an inch, and one of the great features that Mr. Ashford lays down is the great benefit of this trapezoidal section of the wire. The wire is wound round under considerable tension and it binds these rods together very firmly and of course as they are only rods you can see that they give absolutely free percolation through these tubes.

There is a drawing in the paper of these windings, where the direction of the water is shown. There is a fine knife edge there and directly a particle of sand passes into the tube it is sucked clean away from the tube, and is shot out and does not pack up against the tube. That is all very well in theory. But I can say after inspection of these windings that this knife edge is not as perfect as is shown here, and also the attrition of the grains of sand being drawn through it at a fairly high velocity and rubbing against it, may wear away this knife edge, and in my opinion, this pezoidal form of wire winding is very little better from a theoretical point of view than the round wire. However, that is a matter for the patentees. Then you will notice if you will turn to the plan at the end, the method of connecting the suction main advocated by Mr. Ashford direct on to the tube. You will see the method shown there is the Ashford method of coupling. He turns the suction pipe through a right angle and fixes a foot valve and couples his pumps absolutely direct on to the tube. Now the other system of pumping through these tube wells where you can get a spring-level high enough to give you water in a sump, is to sink a masonry sump well about 10 or 12 feet below the spring-level, and terminate the tube with the free orifice into the bottom of the sump well, leaving water in the sump well. Now, one of Mr. Ashford's claims for this is that it is a very cheap form of connection, whereas Brownlie prefers to get 7 feet pump head against the tube and to connect into a sump with water in it and to pump it out of that just as you would out of any ordinary well. I think the Ashford arguments for the direct coupling are open to a certain amount of criticism. In the first place, with inexperienced engine drivers and a municipality clamouring for water, with the possible clogging of one or two tubes or the possible break-

down of a tube, you will have difficulties. The engine driver is coerced, and he whips up his engine and in my opinion will break down the remaining tubes. Whereas in the Brownlie system of pumping direct from the sump, you put a check on the engine driver, and you are able to see the exact discharge your tubes are giving, and you can collect in the bottom of the sump well any little sand that is drawn up through the tube and collects in the bottom of the sump well and this can be removed by hand. Another advantage is having the open mouth of the tube in the bottom of the sump well. You can drop a plumb and find out how much sand has collected. You cannot do that in the Ashford system of connection without uncoupling his foot valve. I may say that all I can do is to express the pious hope that these tubes will not let us down at Sialkot as we have put all our eggs in one basket and put down six of these tubes there, and I hope they will be a success. I hope in a year or two to tell you whether they are or not."

Mr. C. H. West :—"This question about the pump head put on wells was gone into by me with Mr. Brownlie at Amritsar. We tested a 7-inch tube and we found that the pump was delivering 28 thousand gallons a minute, and the pumping head was 9 to 10 feet. The whole question about what head you can use for any of these tube wells depends on the grade of sand you have, and the velocity with which you permit the water to pass through the strainer. For an ordinary fine quality of sand half-an-inch a second is a sufficient velocity, if you are working with a 7-foot head with a 5-inch tube, if you want to work with a 14-foot head with the same velocity you will increase your tube from 5 to 10 inches. The amount of yield from a tube well varies directly as the head. So that if you decide the head you wish to work to, you fix the size of your tube. If you are working to a 7-foot head you put in a 5-inch tube If you want to work to double that head you increase the diameter of the tube.

In the case of the experiments described in this paper, the head was different in the two cases. The head on the Brownlie tube was limited to 7 feet and the head on the Ashford tube head was unlimited.

At least I understand that in the Ashford tube there was no limit to the head employed, though I may be mistaken in this. That is an important point, because with sand coming through in the two tubes, the velocity in the one tube may have been sufficient to carry the sand up the tube and in the other case it may have been just too low for this and allowed the sand to be deposited at the bottom of the tube. I do not think that the tests were made under identical conditions. There was one other point which Mr. Montgomery mentioned as to the suitability of these tubes to all conditions. I think he said that 70 to 80 feet from the surface was about the limit. Well, I do not see that there is any reason why we should not draw the water from any depth. In our experiments which we are carrying on in Cawnpore we strike the sand strata about 270 feet below ground level and we intend putting down the tube wells at 270 feet below the surface, and I have no reason to anticipate that it won't be as successful as putting the strainer 10 or 15 feet below the surface, if you get suitable sand of sufficient thickness to supply the water you want."

Mr. H. O. B. Shoubridge.—"In Gujarat we are sinking a large number of artesian wells. In those we have no strainers at all. We have a tube well in which the water does not rise to the surface, and we carry out pumping operations from it without any strainers at all. The diameter of the well is about 5 inches.

The only question that I would like to ask is what is the life of these wells. Does anybody know what the life of a tube well is"?

Mr. Montgomery.—"With regard to Mr. West's remarks about the pumping head put on the two tubes at Ghazi, I thought I

had made it quite clear that they were tested under identical conditions For the conditions to be identical the heads must have been kept at least approximately the same. As I tried to explain to you regarding the methods of action of these two tubes—one, the Brownlie discharged into a sump of water where you can make recuperation tests as slowly and as accurately as possible with a stop watch. As regards the Ashford tube, which is coupled direct to the suction main and to which this form of test is inapplicable, I must say these two conditions were not the same. But what we endeavoured to do was to be impartial and fair to both parties and we endeavoured to put the same head against both these tubes. With regard to the Brownlie, we put a seven-foot head against it and no more is to be said.

We had high speed Gardner oil engines directly coupled to centrifugal pumps. The engines were new. They were working both just as they had left the maker's hands and were in perfect condition. What we did was this. We ran the engines for the Brownlie at a constant speed keeping a 7-foot head on it and we ran the engines for the Ashford at the same speed and we assumed that the discharge from this head against both would be the same. It may not have been absolutely accurate, but it was the nearest we could do. The next thing we did was—we put a head against the Brownlie at 5, 6 or 7 feet head and we put a vacuum gauge on the pipe and we did the same for the Ashford, and we pumped against the same pressure for both. There was no other means to my knowledge of otherwise comparing the heads against the two tubes. We did our best. With regard to what Mr. West said about the 7-foot head against the tube and one of the statements made in this paper that Mr. Brownlie limits his head to 7 feet, I would refer to page 4 of the Empire Engineering catalogue. At the bottom of the page it is distinctly laid down that the tubes should be educated from the start. That is to say, they should be pumped on slowly and gradually so as to form a coarse filtering medium round the strainer. And he says here that the pumping should be started gradually and continued for several hours at a time at a one-foot head and then at a two-feet head, and so on, until the maximum capacity of the tube has reached a 7-foot head."

Mr. West.—"I tested the tube at Amritsar."

Mr. Montgomery.—"I quite agree with you there. But we based our statement on the statement made in his own catalogue that the maximum capacity of the tube is reached at 7-foot head.

I absolutely agree with what Mr. West said. In my opinion it is an erroneous statement made by Mr. Ashford that you can put an unlimited head against any tube and I am of Mr. Brownlie's opinion as regards the limitation of the tube. Then he criticised my remark where I said that the strainer tubes are only suitable where you find sand at a reasonable depth before the surface at 70 or 80 feet. He says he got them down to 200 feet at Cawnpore. Well that is one of the things I am after too in the Punjab. I want to know how I am going to pump water for small towns from a 200 feet depth, and I shall be only too grateful if Mr. West will tell me the form of pump he proposes to use, the method of action of the pump, and whether it will be a plant suitable for placing at the disposal of ignorant engine drivers, and callous municipalities, who do not care a button what happens to their pumping machinery."

Mr. West.—"I think Mr. Montgomery has misunderstood me. The sand water-bearing strata is found at 270 feet and the strainer is there, but the water is under pressure and rises up to the ordinary level of subsoil water which is perhaps 60 or 70 feet below the surface. The point is that water-bearing strata are found at intervals from 60 to 360 feet. But when you find water

at a low level it does not stay there but comes up to the ordinary subsoil water level. As regards the other point raised, whether the different heads were used when pumping from the two tubes, I assume that if you are pumping from two tubes and each is giving a different discharge, if the tubes are about the same size and clearance, the depression head in each will vary as the discharge you get from them."

Mr. Robertson.—"May I ask if anyone has tried raising water by air pressure or the use of the Humphrey pump"?

Mr. Amarnath Nanda.—"I wish to say one word only and that is with regard to the word 'unlimited head' which has been used here I had a talk on this subject with Mr. Ashford, and his contention is that, according to the principles on which he has designed his tube, and has arrived at the diameters of it, and the discharges it is capable of giving, the head is an item which does not count in the conditions which obtain in the giving of the necessary discharges for the tubes. So unlimited does not mean that any head may be put on to it and the tube will stand it; it simply means this, that in his equation the question of head does not enter. Naturally the conditions automatically arrange themselves according to the conditions of subsoil and the description of coarse sand from which the water is tapped, and it may be possible that the usual head is within a maximum range of 15 feet or so. But so far as his tube and the way the straining material is wound round it and coupled direct to the engine goes, you can put on a full load on to it and there is no necessity to slowly educate it up to the full discharge, and the head will take care of itself."

Mr. Madeley.—"One question was asked as to the life of a well."

Mr. Nanda.—"Mr. Ashford is of the view that his tube would require cleaning once in five years. He can guarantee a minimum life of 15—20 years for the tube."

SECTION A.

Second Session.

The Hon'ble Sir Harcourt Butler, K.C.S.I., C.I.E., I.C.S., Presiding.

(a) *Milk Standards.*

Dr. Srinivasa Rao introduced his paper on "Milk and Milk products"* of which the following is a summary.—

"It is a well known fact that the milk sold in large cities and towns is generally mixed with a larger or smaller quantity of water. There are no standards as in England where milk containing less than 3 per cent. of fats or 8·5 per cent. of solids, not fat, is presumed to be adulterated. As there were no such standards fixed in the Mysore province, 160 samples of milk from as many cows of different breeds were analysed. The average composition of the milk of cows of Indian breeds has been found to be as follows :—

Total solids	...	...	12·82 per cent
Ash ...	...	...	0·70 ,,
Fats ...	...	...	4·45 ,,
Proteids	...	...	3·59 ,,
Lactose ...	...	...	4·08 ,,
Water ...	...	...	87·18 ,,

The amount of fat is liable to great variations, ranging from 8·08 per cent. to 1·60 per cent. The variations from the average are least in lactose.

As compared with the milk of European cows, the milk of Indian cows contains about 1 per cent. more of fat and 0·52 per cent. less of lactose.

One hundred and twenty-nine samples of milk from as many buffaloes were analysed, the average composition being as follows :—

Total solids	...	...	14·87 per cent.
Ash ...	...	...	0·75 ,,
Fat ...	...	...	6·07 ,,
Proteids	...	...	3·92 ,,
Lactose ...	...	...	4·13 ,,
Water ...	...	...	85·13 ,,

It was found that as compared with the milk of Indian cows, the fats, proteids and lactose in buffalo's milk, were on an average more by 1·62, 0·39 and 0·05 per cent., respectively. In the case of buffalo's milk the amount of fat is also liable to great variations, from 11·71 per cent. to 3·75 per cent., and the variations from the average are least in lactose. Therefore, in the detection of adulteration, the percentage of lactose furnishes a better guide than the percentage of fat or of solids not fat.

Buffalo's milk is frequently diluted with 2 to 3 times its volume of water and passed off as cow's milk.

After fixing the standards from the analysis of 315 samples of both cow's and buffalo's milk and taking the average percentage of lactose as 4·1, an examination of milk sold in the bazaar was undertaken. It was found that 78 per cent. of such milk was buffalo's milk mixed with water. A rapid and easy method of estimating lactose in milk was devised with the aid of Purdy's reagent.

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Soured milk, or butter milk which is in common use in India, was examined for the determination of acidity. It was found to attain its maximum on the 2nd or 3rd day and then to diminish gradually. After 5 or 6 days, putrefactive decomposition set in. As yeasts were constantly found to be present in butter-milk, their action in producing alcoholic fermentation of lactose was determined. It was found that after a fermentation of 24 hours, the amount of absolute alcohol by weight was 1·05 per cent., that it attained its maximum on the 3rd day with 1·87 per cent., after which it began to decrease, the amount on the 9th day being 0·47 per cent.

Ghee is another milk product in common use in India. The stuff sold in the bazaar as ghee is almost always adulterated with all sorts of animal fats, vegetable oils, starches, paraffin, etc. The Reichert-Meissel figure was taken as being by far the most important single determination in establishing proof of the character of the sample for evidence in court. The figure for buffalo's ghee was found to be 15·4. From an examination of the four animal fats and gingelly oil chiefly used for the adulteration of ghee, 0·6 was taken as the average Reichert-Meissel figure for the group of adulterants. By the aid of these two Reichert-Meissel figures it was possible to calculate approximately the amount of true butter-fat in any sample of bazaar ghee. Of the 62 samples examined, it was found that 3 had no trace of butter-fat, that in 52 its proportion ranged from 1·3 to 93·2 per cent. and that only 7 appeared to be pure ghee.

To test if the estimation of the adulterants by means of the Reichert-Meissel figures can be depended upon in practice, a series of mixtures of pure buffalo ghee and the adulterants in various proportions were analysed, and the resulting figures were found to tally with the actual quantities taken."

Dr. Rao said.—"It is absolutely necessary that standards should be fixed for cow's and buffalo's milk. Unless such standards are fixed, it will be a hopeless task to prosecute milkmen for selling adulterated milk. As buffalo's milk contains a larger percentage of fats ranging from 6 to 9, the addition of 2 to 3 times the quantity of water to such milk will still show on analysis 3 per cent. of fats which is the standard fixed in England Instead of taking the percentage of fats as the standard, I would suggest that any milk which contains less than 4 per cent. of lactose should be presumed to be adulterated unless it is otherwise proved to be genuine. The determination of lactose is a comparatively simple process and can be done quite as easily as that of glucose in urine.

There is no reason why any bacteriological standards should be fixed for milk. The general practice in India is to boil the milk before use, thus destroying all the pathogenic germs that may have found access to it. Moreover, the number of tuberculous cattle in India is so small, that the danger of transmission of tubercle bacilli from milk to children is negligible.

The most important milk product that ought to receive the attention of this Conference is ghee, which is open to such extensive and easy adulteration. Here there is the greatest necessity for fixing a standard. I consider that the Reichert-Meissel number is admirably adapted for this purpose and any person holding a diploma or a degree in Public Health ought to be able to determine it with the aid of simple apparatus that every Public Health Laboratory ought to be provided with."

Dr. P. S. McMahan, in introducing his paper on "The composition of milk of the United Provinces," * said that the milk of Indian buffaloes and cows was richer in fat than European milk; consequently

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European standards were not applicable to it. The other solids of milk would be useful in forming standards for this country.

The next paper was on "Observations on the bacteriological and chemical examination of the milk-supply of Bombay" by Dr. Joshi, with an introduction by Dr. J. A. Turner. The following is a summary :—

"The milk problem in India is most difficult and perplexing. It needs for its proper solution the effective co-operation of the scientist, the practical sanitarian, the economist and the legislator.

There are 48 dairies and 83 licensed milch-cattle stables in Bombay. The number of cows and buffaloes in the city is about 17,000. No statistics are available about the milk-supply from the suburbs.

The various factors affecting the chemical and bacterial contents of Bombay milk are :—

(*a*) Climatic influences, *e.g.*, temperature, humidity, etc.
(*b*) Influences relating to the milch-cattle. *e.g.*, the breed and age of the animal, time of calving, the kind of fodder, conditions of the stables, diseases of the animals, etc.
(*c*) Conditions ascribed to the gowlees or milkmen, *e.g.*, undesirable customs, filthy habits of life, objectionable methods of milking and of transporting the milk, communicable diseases, *e.g.*, tuberculosis.

Three classes of milk samples were examined :—

Class I.—Samples collected under the strictest supervision and examined immediately.

Class II.—Samples collected with ordinary sanitary precautions and examined after 3 or 4 hours.

Class III.—Samples collected at random, and examined after 6 to 9 hours.

The bacteriological examination showed widely different results according to (*a*) conditions of collection and transportation, (*b*) temperature at which the milk samples were held, and (*c*) time elapsing between milking and examination of the samples at the Municipal Laboratory.

The figures for microbes per c. c., and lactose fermenting organisms of the B. coli type indicate a high degree of manurial or other undesirable pollution as judged from samples of class II and class III.

The results obtained from samples of class I demonstrate that it is quite possible to get the purest milk in Bombay, provided that proper precautions are taken regarding milking, etc.

Out of 614 samples of milk examined, not a single sample showed genuine tubercle bacilli, from which it may be concluded that *tuberculosis is rarely, if at all, conveyed by milk, in India.*

Much valuable information can be obtained from a bacterial examination of milk. This is of practical importance to the Health Officer, as it affords the cheapest and most reliable means of finding out any contamination of milk.

The chemical composition of milk in India differs to a great extent from that in Europe or America. Buffaloes' milk which is largely used here is richer in fat and proteids than cows' milk abroad.

The adulteration of milk with water has reached a scandalous point in Bombay,—the percentage of adulteration being nearly eighty (80)—that is, *four-fifths of the milk supplied to Bombay is adulterated with water.*

Milk standards for India are essential. They must be necessarily different from those for Europe and America.

A bacterial milk standard for India is desirable. This should not be legalised until more work is done on the bacteriology of milk,

in India. A tentative standard, however, is suggested for the present as a guide for administrative work.

It is evident from the present investigation that Bombay milk shows an extremely high degree of adulteration and a most objectionable bacterial pollution.

In connection with milk legislation, the Government of Bombay have recently passed Act VI of 1913, certain sections of which provide for the effective sanitary and legislative control of the Bombay milk-supply.

Besides legislation, other remedies are necessary for improving the milk-supply in India. Among these the following are suggested :—

(*a*) An improved and efficient system of inspection of dairies, milch-cattle and stables.

(*b*) Improvement in the proper management and care of the milch-cattle. This includes better breeding and housing, provision of cheap and proper fodder, etc.

(*c*) Education of the milkmen and other milk dealers regarding sanitary methods of collection and distribution of milk, personal hygiene, etc.

(*d*) The adoption of artificial methods for purifying and preserving milk, *e.g.*, pasteurisation and sterilisation.

(*e*) The establishment of model milk farms in the suburbs of large cities.

(*f*) The use of modern methods of transportation of milk from producer to consumer, *e.g.*, milk trains, motor waggons."

Dr. Turner said :—"The question of milk standards is most important. To have a chemical standard and a bacteriological standard was absolutely necessary, but whether the time was ripe for a definite bacteriological standard was a matter for consideration. There is adulteration of milk and contamination of milk, a vastly different thing. He understood that there was at the present time a Bill before the Imperial Government to amend the Act relating to food and drugs. Milk, butter, ghee, and oil were the chief foods in this country which could be adulterated, and the question of a standard should be considered in this respect. The standards would differ in every locality, but they could be fixed by competent persons on the spot. People could not be prevented from selling adulterated milk unless a stringent Act, such as they have in Bombay, were passed. The chief safeguard in India would be the bacteriological standard. People died of diseased milk and not of adulterated milk unless it contained some disease bacteria. Analysts should be appointed in certain districts and in every large municipality, who would be capable and willing to undertake the analysis of milk."

Sir Pardey Lukis.—"I want to say a few words about milk standards as regards condensed milks. The paper of Mr. Cowasjee shows that last year about 13 million pounds of condensed milk came into India, which was about double the amount that came in 6 years ago. It is obvious therefore that condensed milk is a very important source of food supply and that it must be considerd both from the point of view of the chemical and bacteriological standards. As regards a chemical standard, two proposals have been put up with reference to such standards, the first is that all condensed milk shall be required to be prepared from milk which contains not less than 3 per cent. of fat. This is the legal minimum at home, and the proportion in the tin would of course be in accordance with the amount of condensation. The second proposal is to adopt a fixed percentage of milk fat for each tin, sufficiently high to justify its description as being prepared from full cream milk. I consider that the second plan is the better, and in view of the fact that whatever minimum we may fix will certainly be the ordinary maximum of the

supplier, I suggest that this limit should not be less than 11 or 12 per cent. of fat in each tin of milk which is sold as being prepared from pure cream milk. The second point is as regards the bacteriology. In this connection I invite reference to a paper by Andrewes on the cytology and bacteriology of condensed milks. As regards the bacteriology, he states that he has examined by culture 45 samples, 43 of which were machine skimmed products, and that in the whole of these 45 he found living bacteria In 31 of these samples he obtained almost pure cultures of Staphylococci amongst which *St. pyogenes aureus* was conspicuous and even predominant. He says also that he found the bacterial contents of the milk, as determined by broth cultures, to lie between 100,000 and 1 million microbes per c. c. He also found, as a result of experiment, that condensed, sweetened milk is a differential culture medium for Staphylococci, for whereas they would multiply freely in this medium, *bacillus coli* and others would not do so. He goes on to suggest therefore that the presence in reasonable numbers of the bacteria commonly seen in fresh milk, that is to say, *bacillus coli*, *Bacillus enteritidis sporogenes*, and a few streptococci and staphylococci and the ordinary air contaminations such as *B. subtilis* and *B. mesentericus* might be regarded as being unobjectionable ; but that if you got a large number of *Staphylococcus aureus* in the condensed milk (say quarter of a million cocci per c. c.), it is for consideration whether this condensed milk can be regarded as a wholesome and desirable food for an adult, much less for an infant. I do not profess to be able to give an opinion on this ; I simply put it before the Conference as a matter for consideration, whether the fixation of bacteriological standards for condensed milk is not as important as in the case of the natural product."

(*b*) *Milk Trade.*

Dr. H. H. Mann then introduced his paper "The supply of milk to Indian cities," * in which he states that the "milk-supply to Indian cities is admittedly unsatisfactory, both as regards quality and quantity. Measures undertaken to remedy this state of affairs should on no account result in any increase in the price of milk. The problem of improving the supply without a material increase in the cost is a difficult one, but is capable of solution.

An account of the milk-supply to the city of Poona as derived from inside and outside sources is given in detail. It is shown that while the bulk of the milk comes from animals housed within the city limits, a considerable quantity is carried in by hand from comparatively limited areas within a six to nine mile radius. The method of distribution is uneconomical and involves a great waste of labour and energy. Numerous analyses of milk samples demonstrate the frequency and shamelessness of the adulteration of milk with water. In fact, adulteration with water is the rule, the amount of added water varying almost directly with the price at which the milk is sold. This applies to milk obtained from all sources, within and without the city.

The author notes that while private owners keep cows for milking purposes, the traders keep buffaloes as a general rule, the buffalo being the more profitable.

A detailed examination of the cattle and cattle-sheds is given. There is no organised control, and lamentable overcrowding and insanitary conditions prevail.

Taking Poona as a typical city the conclusions are :—

(1) The milk-supply is partly (about one-fifth) brought from outside the city, from the immediate neighbourhood, and chiefly by hand in small quantities.

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(2) The remainder is produced inside the city from animals kept for the most part in unsatisfactory and insanitary small sheds.

(3) Except for animals kept for private use, about *ninety* per cent of the milk is produced from buffaloes.

(4) The milk as it enters the city from outside is already adulterated with water, the adulteration varying with the price. No milk costing less than 4 seers per rupee can be expected to be pure.

(5) Milk within the city is adulterated to a greater extent.

(6) The practice of adulteration is increasing in shamelessness, the amount of water added is greater and greater as the price of pure milk tends to rise.

(7) The dirt in milk is not so great as would be expected from the insanitary and dirty conditions under which the milk is produced.

The author asks the question—What can be done to deal with the situation, both as a piece of sanitary improvement and as an agricultural problem?

As regards the former, it is obvious that improvements in sanitary control are necessary, for the trader, the cattle, the cattle-sheds, and dairies.

The agricultural problem lies in the direction of organisation and improvements in the dairy industry.

The breed of cows and buffaloes, and their milk producing capacity, must be improved. The animals should be kept outside city limits in cheap and natural surroundings, and arrangements made for prompt, easy and cheap transport by road or railway.

Large dairies can certainly be run successfully and at a profit if carefully located and managed, as witness the Military Dairy Farm in Kirkee.

Apart from the establishment of large dairies, the only method of ensuring a pure milk-supply at a cheap rate is the organisation of village production and transport on co-operative society lines. The successful experience of the Vishweshwar Co-operative Dairy at Benares is quoted as illustrating the possibilities as well as the difficulties of this line of action."

Dr. Mann thought that his paper was the first complete examination of the milk-supply in a large Indian city. On investigation among the low caste population of Poona, he had found that they were dying out, and that the population was only maintained by continuous importations from outside. He concluded, after considering other possible explanations, that this was due to the enormous amount of infantile mortality among them, and this naturally led to a consideration of the question of the milk-supply. In Poona the quantity of milk consumed per head was extremely small, not amounting to more than ¼lb. per head, but at the same time was very largely adulterated. Unless 2 annas per pound were paid, it was impossible to get unadulterated milk. In exact proportion as less was paid, water was added. The milk supplied in Poona city was not nearly so dirty as he had expected it to be; not more than 10 per cent. of the milk examined by him could be described as decidedly dirty, the remaining 90 per cent. would, even in England, be considered fairly clean. The question was, what could be done? In initiating any measures the great difficulty that would be encountered was that higher prices would follow improvements in the quality of milk, with the result that the lower classes would be deprived of this article, and this might do more harm than good. The three measures which he advocated for coping with the problem were :—

(1) The milk of each animal should be increased as far as possible.

(2) Cattle should be removed to cheaper surroundings outside cities.

(3) The supply of milk to cities from outside should be organised and controlled.

Dr. Newell :—A few facts about the Lahore milk-supply might be of interest to the Conference. Cow's milk is sold at the rate of *two annas per seer* and buffalo's milk at 2½ annas per seer ; at shops boiled milk is sold at half-an-anna more. The milk is bought at wholesale rate at half-an-anna *less* per each seer. That is to say, shopkeepers get their milk from *Gujars* at 50 seers per maund (called their "pucca" maund) and they sell at 40 seers to the maund. In other words, they get 50 seers for Rs. 5 and sell 40 seers for Rs. 5, *i.e.*, a profit of Re. 1-4 on every 5 of unheated milk. Buffalo's milk is bought at 50 seers for Rs. 6 and sold at 40 seers for Rs. 6.

The highest retail price is 5 annas per seer (*i.e.*, 3¼ seers per rupee), the medium and usual price is 2½ annas per seer (*i.e.*, 8 seers per rupee), and the cheapest milk is sold at 2 annas per seer (or 6½ seers per rupee). Buffalo's milk costs ½ to 1 anna more per seer. The main fluctuations are during the Mahommedan *Ramzan* month and the Hindu "Sradh" days.

The total amount of milk brought into the city from villages is 100 maunds daily.

Cost of feeding cattle

The cost of food per buffalo is 12 annas per day ...		when gram is given.
„ „ „ „ „ cow „ 8 „ „ „ ...		
The highest cost of food per buffalo is	1 rupee ...	without gram.
„ lowest „ „ „ „ „	8 annas ...	
„ highest „ „ „ „ cow „	12 „ ...	
„ lowest „ „ „ „ „ „	5 „ ...	

The most *channa* (gram) given to a buffalo is 8 seers per day (4 in the morning and 4 in the evening), and the most given to a cow is 5 seers a day. There is a belief that every seer of gram gives a seer of extra milk and richer cream. Each seer of milk is believed to give 2 oz. of cream. Oil-cakes and cotton seeds are also given to increase the cream of milk, but this is only among the richer sellers and private individuals. cauliflower leaves at annas 2 a maund are used and while the quantity of milk increases, the cream is less. Among the poorer persons, or those who keep more cattle than they profitably run, the feeding is very bad, and cheap food with manure is common. Many dirty practices prevail and one of the dirtiest is that of putting the tail into the rectum with the idea that the udder would be pressed upon and so more milk exude. I have seen a young man proceed to milk a buffalo after thus filling up the rectum, without washing his hands. Clean milk is impossible with such practices. The conditions arise from ignorance, and any idea of trying to improve the cleanliness of milk, of sheds or dairies by license conditions or by standards will absolutely fail without some attempt at teaching the gwalas that cleanliness can be attained by simple measures.

Rai Sahib Wazir Singh referred to the increasing prices of milk in Delhi owing to the absence of grazing land and the transfer of the Capital. Free grants of grazing land and free sheds should, in the first instance, be provided for gwalas. Supervisors should be appointed and milk vendors licensed.

The Hon'ble Mr. Ramachandra Rao laid considerable stress on the necessity for increasing the milk-supply which, he thought, deserved greater consideration than the question of milk standards. The question of adulteration would recede to the back-ground, once steps were taken to increase the supply of milk in the market. He agreed with Dr. Mann that cattle should be removed to cheaper surroundings outside the city owing to an absence of culturable land growing succulent fodder in towns and cities. A better class of milking cattle should be introduced, and facilities provided for increasing the food-supply in the vicinity of towns. He was glad to see that the question had attracted the attention of the Board of

Agriculture. The question should be considered in the Agricultural Department, and, as in the case of most sanitary questions, there should be a great deal of co-operation between various departments if any result was to be produced. He would like to ask Dr. Mann whether in the course of his enquiries at Poona he had taken into account the consumption of soured milk, curds and butter-milk.

Dr. H. H. Mann said he had not made any special enquiries in this respect, but his figures gave the total amount of milk of all sorts coming into the city.

Dr. Sousa handed in the following note :—"The dairies in Lucknow are mostly situated in the congested areas and 227 of them were licensed in the past year.

In my last annual report I pointed out to the Municipality the objections of having these dairies in crowded localities.

(1) That milk is liable to great contamination in congested areas

(2) That animals pollute the surrounding air by their respiration and excreta.

(3) That anopheles mosquitoes haunt dairies and cattle-sheds, which are therefore potential sources of the spread of malaria.

(4) That it has been noticed that small-pox starts in the neighbourhood of dairies. In the last epidemic here, the first cases started near the dairies in Nayagaon. The close relationship existing between the various kinds of variola found in man and animals is proved by their reciprocal power of conferring immunity. The exact relationship between small-pox and dairies has not yet been demonstrated, and investigation on the subject would be of great value.

In my opinion dairies should not be very far away from the town, as on account of transport, prices will go up, and such dairies will lack the necessary supervision.

I think the most suitable place would be the outskirts of the main *abadi* of the town where water-supply and masonry drainage is available. Convenient places should be selected and acquired and run on co-operative principles. Municipalities cannot hope to run dairies successfully perhaps, on account of unavoidable wastage. They should encourage and help as much as possible co-operative concerns which are after all for the benefit of the public.

Before starting any model byres, the milk consumption of the city should be estimated, and accordingly housing accommodation for the necessary cattle should be provided. Having done this, sanitary milk depôts should be established all over the city just like meat shops. Then the Municipality will be in a position to have prohibited areas within which no milk will be allowed to be sold other than that which comes from model byres."

Mr. Robertson.—"The milk pails I show here (exhibited) are supposed to be the best of their kind. They are made to be locked or sealed, and as the only object in locking or sealing a pail is to prevent the milk being fraudulently extracted, and to prevent water being added, I take it these tins are supposed to perform these functions. I find, however, that the whole contents of the pail can very easily be emptied past the locked or sealed lids, and by placing the closed pail into a bucket of water the extracted milk can very easily be replaced by water.

By springing a rubber ring on to the lid of this pail it should be possible to make it water-tight. Mr. Gubbay suggested to me this morning that the handle part of the screw-catch might be made to move on the lid, so that the rubber ring would not be rubbed while the lid is being put in place. The ring will certainly last better if this is done. The pressed in portion near the mouth of the can should be done away with and the bottom of the pail should be fully

rounded. The pail will then in my opinion be very suitable for the distribution of sterilised or pasteurised milk.

With regard to Dr. Mann's paper, my experience in Darjeeling has led me to the same conclusions:—To get the milk into the town from the outlying busties, I have estimated for a ropeway to Jorpukri near the Nepal frontier and for another to the Sikkim boundary. These ropeways would bring in most of the milk which is at present brought to the town on men's backs and so release labour which might be more profitably employed on the farms.

For the improvement of the quality of the Darjeeling milk supply I propose to have a depôt in the bazar, in charge of a trained man and under the supervision of the Civil Surgeon.

This depôt will receive, clean, test, bottle, classify, and sterilise or pasteurise any milk brought to it. There will be no compulsion on the gwalas to bring their milk to the depôt, as it is best to begin a scheme of this kind as gradually as possible, at the same time beginning with a fully organised system. The idea is to arrange things so that it will pay the gwalas to bring their milk to the depôt.

To make a start the Civil Surgeon will be asked to refuse to sanction anything but milk in depôt sealed vessels for one or two of the institutions under his control.

When the staff gain experience in the use of the apparatus, other institutions will be brought in, and notices will be sent to every house-holder informing them that cleaned and sterilised milk is available.

The test will be made with a butyrometer and the prices fixed will be on butter-fat contents.

If a gwala cares to water his milk, he may be allowed to do so, but the watered milk will be penalised to a slight extent so that he will get less money for his milk watered than he would have got for it whole. The shape, or the colour of the seal or a number on it, will indicate to the consumer the value of the milk he is buying.

With regard to the rules under the Bombay Act, I should like to know how some of them are to be enforced. Rules 3(*a*) and (*b*) as quoted in Dr. Joshi's papers are almost impossible to enforce under present conditions in India and Rules 5 and 6 are almost as difficult.

The Hon'ble Mr. Cowasjee asks about floors for cattle-sheds. I have used tar asphalt macadam with some success, but this, too, gets cut up if badly treated.

He says that if gwalas are to be expected to put up good buildings they must have long leases.

In my opinion the power to order destruction of dairy produce should be given only to fully qualified medical men of good standing."

The Hon'ble Mr. Merwanjee Cowasjee.—"As a non-official delegate from Burma it affords me much pleasure to have the opportunity of attending a Conference of specialists and scientists from various parts of India, and of following the very interesting discussions that take place at this assembly. I am sure I shall carry back with me valuable knowledge and information for the benefit of the people of the province whence I came. The question of a pure milk supply is intimately connected with public health. It has therefore occupied the serious attention of the Municipal Committee of Rangoon of which I am a member. I submit to this Conference a paper* on milk supply in which my views are fully set forth. Much light, however, might be thrown on this important subject by the wider knowledge and experience of the delegates present here from other parts of India, and I therefore cordially invite discussion."

The following is a summary of the Hon'ble Mr. Cowasjee's paper referred to above.

"The public control of milk is of paramount importance in India where it forms such a very important article of diet of the inhabitants

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Attention should be directed to the milk supply as to the wate supply.

Unfortunately, the habits and customs of the traders in milk are dirty and insanitary. It is necessary then, that the milk dealers should be educated and taught the value and importance of cleanly habits and sanitary surroundings, of himself, his cattle and his cattle-sheds.

Any general improvement in condition means expenditure, and, as the individual *gai wallah* is unable to provide funds himself, assistance from local bodies is essential.

In Rangoon, the milk dealers live outside municipal limits, are squatters on Government land, without any security or permanence of tenure. They cannot be expected to spend money on model sheds, pucca floors, or good water supplies.

The following recommendations are made :—

(*a*) That sheds be built by the local authority and let out to the cow-keeper at a reasonable rent, or that advances be given if the cow-keeper is prepared to build sheds himself;

(*b*) a tenure of land should be arranged so as to make it worth the while of dealers to spend money on sheds ;

(*c*) grazing ground should be reserved for cow-keepers.

The increase in the imports of condensed and tinned milks is referred to, and it is pointed out, that the use of such milks is economically wasteful. India is able to, and should produce all the milk that is required as food-stuff.

The extension of dairy farming on modern lines is desirable, and the Agricultural Department should play its part in educating the agricultural population in matters pertaining to milch cattle.

Finally, the author describes the measures proposed for Rangoon, which consist of a central milk receiving depôt under the charge and supervision of the Health Officer and Veterinary Officer, the former testing the milk and the latter inspecting the cattle.

All milk dealers are to be licensed and controlled.

Measures such as these should be made generally applicable, both inside and outside municipal limits, and, if necessary, further legislation enacted for the purpose."

Dr. K. V. Amin then introduced his paper on "Milk Trade,"* of which the following is a summary :—

"The author advocates municipal enterprise and suggests the provision of model dairies. Cattle-sheds should be located outside city limits and so located as to facilitate inspection and supervision.

All cattle-sheds, dairies, and milk dealers should be subject to a system of licensing and control, and, if necessary, additional laws enacted for the purpose.

To prevent adulteration of milk, a minimum standard of composition should be established, and all vendors compelled to indicate clearly their names and addresses on prescribed types of milk cans. Also on milk shops the description of the milk sold should be shown, *e.g.*, separated milk.

Health Officers should be empowered to take samples of milk and analyse them, and to condemn unwholesome foods when necessary.

The employment of veterinary staffs is recommended to inspect cattle, cattle-sheds, dairies, and milk shops ; and municipal analysts should examine milk, butter and ghee.

If necessary, prosecutions for fraudulent adulteration of milk and food-stuffs should be frequently instituted, and exemplary punishment inflicted whenever adulteration is discovered."

Dr. Amin said :—"Cleanliness of milk is much more important than its richness, inasmuch as the want of the former is positively

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dangerous. Hence the stables where milch-cattle can be stalled should be constructed by municipalities well away from the populated area where they can be under full control of the municipal authorities. The land away from the congested areas being cheaper it would not, I think, increase the cost of milk.

Model dairies can be kept for educative purposes and the milk can be humanised for infants of various ages, and sold at cost price or even given free to infants of the poor, at milk dispensaries.

Shortage of milk is a direct incentive to adulteration, and I think ample pasture lands on easy terms would go a great way to increase the number of milch-cattle and improve the quality of the milk."

Major Stokes introduced his "Note on milk supply," in which he gives a brief account of measures adopted in the Central Provinces to provide a reasonably pure and wholesome supply of milk by the establishment of dairies under the supervision of the Agricultural Department.

The Nagpur dairy is described. The principle of a co-operative society has been adopted by the *gwalas*, and in spite of the numerous difficulties, such schemes offer a possible solution of the very difficult problem of supplying pure milk to consumers.

He said :—"My note is really a description of an experiment by the Agricultural Department in the Central Provinces. I think it is particularly interesting in that it combines all the three methods mentioned by Dr. Mann as possibilities for ensuring a good milk supply without increasing its price, *viz.*—

(1) Increasing the yield of milk per animal. This is done by suitable fodder and by offering facilities for breeding with higher strains of milch animals.

(2) By stabling outside towns.

(3) Using co-operative methods.

The financial results are most encouraging as is also the fact that the demand far exceeds the supply."

The paper "A short note on milk supplies," *by Captain H. B. Stiles Webb, I.M.S., was taken as read.

Dr. J. B. Stephens referred to the difficulty of controlling the supply of milk from outside municipal limits. The milk came into the cities adulterated and often contaminated, and the municipality should have power to control the supply. His experience was that as soon as measures were taken to control the supply in towns and cities the *gwalas* moved outside municipal limits and thus eluded control.

Dr. Mann emphasised the necessity for organization preceding restriction. If restriction were applied before organization the conditions would be much worse, from a sanitary point of view, than at present. They could only succeed if they co-operated with the *gwalas* and did not work against them. To effect sanitary improvements sanitarians must work in co operation with the Agricultural Department. The co-operative experiment in the Central Provinces was very hopeful. Measures such as these were likely to be more beneficial at present than restrictive proposals such as penal legislation, licensing, etc. He was very glad to have had this opportunity of insisting, before the Conference, on this side of the question, because when they looked at the question purely as sanitarians, they so frequently regarded it exclusively from the point of view of restriction, whereas in this case restriction was the very last thing and organisation the first thing.

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SECTION B.

Second Session.

Mr. W. Hutton, Presiding.

(*a*) *Municipal Drainage.*

Mr. J. W. Madeley introduced his paper on "The exclusion of storm water and silt from sewerage systems."*

The paper refers especially to the Sewerage System of the City of Madras.

A description is given of the evils resulting from the free admission of silt and storm water into the various parts of a sewerage system. House connections, the sewers themselves, pumping stations and pumping mains, are separately considered.

Detailed measurements made by the writer are described.

The measures adopted and apparatus used in Madras to exclude storm water and silt are then described. The chief are :—

(1) The arrangement of low curbs to effect the separation of sewage from rain water in the drainage of the smaller Indian houses.

(2) "Silt-catchers" fixed on house connections.

(3) "Storm water Separators" with which are combined silt-pits, to exclude silt and storm water from entering the sewers at the points where open drains are connected to the underground system.

(4) The arrangement at the pumping stations of screens to remove floating matter, and of pits to catch the silt. A special apparatus known as the "Madras Silt-raiser" is described. By means of this apparatus the silt deposited in the pits is raised to ground level.

The paper is illustrated by six plates showing :—

(1) A case of deposit of silt in a Madras sewer.

(2) The arrangement of curbs to effect separation of rain water and sewage in a typical Madras house.

(3) The "Madras Silt-catcher."

(4) The "Madras Storm-water Separator."

(5) Typical arrangement of silt-pits and screens at a Sewage Pumping Station.

(6) The silting up of a Pumping Main in Madras.

Mr. Madeley said :—"My paper deals with two of the most serious problems that we have to meet with in the drainage of Madras. In introducing a sewerage system in a country like India we are adopting systems which have proved successful in the West with people of Western manners. The conditions in India are different, and they must be carefully studied and suitably dealt with if sewerage systems are to be successful.

The exclusion of storm water and silt are comparatively simple matters under European conditions. But out here with the lower type of Indian houses they are far more difficult and we have found it necessary in Madras to adopt special methods. The evils resulting from the free admission of storm water are well known. In cases of sewerage systems like that of Madras and other flat towns, where all the sewage has to be pumped, it is always necessary to adopt a separate system.

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If rain water is to enter the system freely the whole of the sewers become congested and sewage entering at the higher points overflows at the lower points, through manholes into yards and sometimes into the houses themselves.

Silt is also a most serious problem. It interferes with the working of our systems everywhere. It begins with our house connections, which are furnished with traps. In the lower type of Indian houses we find silt enters the trap freely, and the system in Madras, in those cases where there is no special apparatus for removing it, the silt has to be removed by hand ; it is taken out of the trap and placed on the side of the road until it can be removed by the conservancy department. I see from other papers submitted to this Conference that this daily cleaning of traps is not peculiar to Madras, but has been found necessary in other cities in India. Silt in quantity chokes up flat sewers, and even with the best graded sewers it will form deposits which will require a great deal of cleaning out. Then, if the sewers are at all well graded, a large quantity is carried to the pumping stations. In times of storm it pours into the pump wells and obstructs the suctions of the pumps and stops their action. In this connection it is rather interesting to say that in Madras we find the life of a pump valve is only about one month, while in England it varies from 10 to 20 times that length.

I will now proceed to describe the methods we have adopted of dealing with these troubles. Of first class houses drained on European lines I need not say anything, because the methods used are the same as those used in England. In the smaller houses there are open brick drains to deal with the sullage water. The question arose whether these brick drains should be replaced by pipes. It was decided that in Madras for the present this would not do. It can be introduced only by very slow degrees. In Bombay I understand that they had to take out pipe drains laid into the houses. The method we adopt is to construct small curbs to keep the rain water out of the sullage drain, and to make a separate rain water drain. The method of doing that is shown on plate II. This is quite an inexpensive method. The cost varies from Rs. 26 to about Rs. 70 per house in the case of old houses according to the size of the house. In the case of new houses the extra cost would be practically negligible. In some cases rain water and sewage drains are covered for short distances, but for short distances only, as ready access and ease of cleaning are considered to be of the greatest importance.

It will take some time to get this alteration in the house drainage carried out in Madras. In the meantime—and even after it has been completed—large quantities will still get into the open drains, and to exclude it from the sewers, or at any rate to ensure that only a negligible quantity shall get in, we have introduced a special apparatus which I call a "silt-catcher."

This is an iron bucket placed on the upstream side of the trap as illustrated on plate III. The engineering department, that has to clean the sewers, has asked that we shall put these silt-buckets on the worst roads, and the Health Department, that controls the conservancy, have asked that they should be fixed on every house connection throughout the city. (Mr. Madeley here illustrated by diagrams the use of the silt-catcher and how it is worked.)

The silt-catcher bucket is found to be economical, it is cleanly, and we find it perfectly satisfactory.

The methods just described are those that we adopt in the case of the ordinary Indian house in Madras. These houses form the large bulk of the houses in Madras, but for a long time to come there will be collections of huts to which we cannot give separate connections. In these cases latrines are provided for the use of the

inhabitants, and good open drains are used to take away the sullage water from the kitchen, etc. These open drains are protected by curbs to prevent silt, storm water, sand, and rubbish getting in to them.

Where these drains are connected to the sewers we have had to adopt special means to exclude storm water and silt. Where possible we use ordinary methods of separating the storm water, such as the ordinary overflow weirs, leap weirs and plate weirs.

But in general in Madras none of these are applicable because we have no system of storm water underground pipes, and the roads are flooded with water, so that any ordinary weir would simply provide an opening into the sewer through which the storm water would rush. So we have to devise a special method called the storm water separator.

(Mr. Madeley here illustrated the special form of separator that he had designed in Madras.)

Some silt gets through into the sewers. It is only the heavier silt that we try to exclude, in spite of this apparatus a good deal does get down to the pumping stations. I do not know of any simple method that has been adopted for removing silt from pumping wells. One way is to have it removed by hand. That is a possible but a dirty method. Another way is to use dredgers, but those dredgers are not satisfactory as a rule. They give a lot of trouble and use up a great deal of power. I have designed a special method which is illustrated in one of the plates. This is a method that we have adopted in Madras and we are installing at all the new pumping stations. (Here Mr. Madeley illustrated his apparatus by means of a large cartoon.)

There is one other cartoon I have got here. It is of sufficient interest to show you what happens to a long pumping main if you do not exclude the silt."

Mr. Madeley then explained a large cartoon of a cast-iron sewage pumping main in Madras. The main is some 9 miles long and from Mr. Madeley's experiments he found that it was half full of silt.

Mr. R. J. Kent.—"I want to know what the life of the gland is, and whether it requires periodical or constant renewal. There is another point which I would like to refer to, and that is with reference to the ingenious methods of collecting silt shown in the last diagram. It seems to me that it occupies a considerable area of the street. A number of such masonry platforms along a street would form an obstruction to traffic."

Mr. West.—"I would like to ask if Mr. Madeley has ever tried the effect of reducing the section of the pipes in those depressions where he has got to work against gravity, I mean so as to get a velocity of 5·7 which you need in a syphon to keep it clean. It would mean an increase in the pumping head for short sections, if the depressed portions are not very long. If they are very long depressions it won't do to reduce the pipe sections, as the pumping head which you have to work against might become excessive. If Mr. Madeley reduces the section of his main just at the top of a depression so as to get a velocity up to 5 and three-quarter feet, it is possible that the silt would not deposit in those low places. Very often if you have got a flow through an ordinary syphon instead of allowing a continuous flow through it, it is an advantage to have a tank and send it through in flushes and let your silt go through at a big velocity. In all syphons the velocity ought to be increased if you want to be saved from trouble in silting."

Mr. Madeley.—"The first question raised was as to whether the silt raiser would require frequent renewal. I can answer that and say it will not. There are practically no wearing parts. The gland referred to is really not necessary. The friction of the very thin long layer of water between the inside and outside pipes is so great

that there is no material interference with the working of the arrangement. Though not absolutely necessary, I have inserted a gland and I think it is a good thing. We have had this apparatus working for two years and working every day, and nothing has had to be renewed. It is working to-day just as well as it ever did.

With reference to the area occupied by the silt-catcher, it certainly would occupy a considerable area in a narrow street if it were put straight out into the street. To save an obstruction, the length is placed parallel to the road and does not take up much area. At the same time in order to reduce the area taken up and the amount of masonry required round the catcher I have now adopted the method of putting the silt-catcher bucket above the trap. In that case it occupies no more room than an ordinary syphon trap.

With reference to the effect of reducing the section of pipes of the pumping main, I am afraid that it would be necessary to reduce the section of about half the pipe so that it would mean reducing the size of your pipe and increasing your pumping head. But that is impracticable. I should say that in an existing pipe that we have to deal with I would certainly not put in a long pumping main for conveying the Madras sewage. I think it has been conclusively proved in Madras that long pumping mains are not suitable for sewage containing silt unless adequate storage can be provided so as to equalize the rate of pumping."

Mr. C. L. Cox, City Sanitation Engineer, Colombo, who was absent, communicated the following :—" I desire to make a few remarks with reference to the interesting paper by Mr. Madeley dealing with storm water and the exclusion of silt from sewers.

I would endorse his remarks as to the necessity of removing silt and rubbish from sewage before pumping.

I consider movable screens of the cage or basket type distinctly preferable to fixed bar screens with clearing rakes, specially when the pump sumps are of considerable depth. In the latter type the raking mechanism is liable to frequent obstruction. Basket screens can be made of smaller mesh to retain greater quantities of vegetable débris. This material floats on the surface of the sewage in the sump and, as it is not all removed by the pump, the accumulation requires removal at more or less frequent intervals. For this purpose suitable means of access to the sumps should be provided."

Mr. J. Ball-Hill introduced his paper "A short note on Sewers,"* of which the following is a summary :—

When towns reach a certain size with a considerable population, methods of disposal of night-soil by trenching, or by open surface drains, become an intolerable nuisance. Some form of underground sewers is then an indispensable necessity.

The system of underground sewers in Calcutta is described and defects pointed out.

Comparatively few engineers in India have had much opportunity of acquiring experience in sewerage projects. The author, therefore, gives a list of essential data necessary in the preparation of drainage projects, with especial reference to conditions in India.

He said :—" I have often been asked what is the minimum gradient to be allowed for pipe sewers. I could only explain that it depends entirely on the conditions of flow to be dealt with. It therefore occurred to me that a short note showing defects in our sewers in Calcutta and giving the principles to be adopted in the laying out of sewers for a sewerage system may be found useful to those who have to prepare projects, however small, in flat areas, and who have had but little experience in the work. I would like to observe with regard to paras. 13 and 14 of my paper that I do not wish it to be understood that the Calcutta sewers can only deal with a rainfall of one-fourth to

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one-sixth of an inch per hour, but that their capacity for discharge is equivalent to those quantities. During the last year the Corporation of Calcutta desired to know the rate at which rain actually falls in Calcutta and obtained and fixed up two self-recording rain gauges—one a Casselles No. 6 tip bucket type, the other Negretti and Zambra's Hyctograph, a float type gauge. During this last monsoon season we have had a total of 86 inches of rainfall in Calcutta. Much above the normal. And we have obtained some most interesting diagrams from these gauges. It would appear from these records that there were 187 occasions when $\frac{1}{4}$ inch fell in one hour; 67 when half-an-inch fell in one hour; 19 when one inch fell in one hour; 10 when $1\frac{1}{2}$ inches fell in one hour; 2 when two inches fell in one hour. A very large proportion of these fell in the half hour. Once 4 inches fell in the hour, of which three inches fell in 20 minutes. The district engineer-in-charge of the lower areas of Calcutta reports that these low areas were only flooded some 9 times during the season. This would seem to show that the sewers are well able to deal with rainfall of four times their capacity or one inch per hour; or even one inch in half an hour: provided the fall does not extend over the hour, and that flooding is only liable to occur when the rainfall exceeds this rate."

Mr Gubbay.—With reference to para. 21 of his paper, I should like to ask Mr. Ball-Hill whether the 24-inch diameter sewer which he mentions is an old sewer or a new one.

Mr. Ball-Hill.—It is quite new. It was built just before 1900.

Mr. Gubbay—And whether the 24-inch size is the minimum size laid down. It has just occurred to me that it might have been left sufficiently large for a boy to creep through and clean it.

Mr. Ball-Hill.—I do not see any reason why as summit sewers only those sewers that are large enough to be got into should be put in. A 6-inch pipe can be cleaned in the usual way.

Mr. Gubbay.—Up to 1909 it was the practice in the Sanitary Board, Bengal, in dealing with surface drainage schemes to have culverts for passing drains under roads, at least 24 inches wide. These were supposed to be cleaned by boys, but subsequently it was determined that pipe culverts should be used, and the conclusion come to there, was practically the same as has been come to by Mr. Ball-Hill in his para. 21, namely, the culverts were too wide.

Mr. Madeley.—There is another explanation perhaps for the 24-inch pipe being carried up to the summit. That is to reach a certain distance with a given gradient. It is a method of designing which has been adopted in many cases and as Mr. Ball-Hill points out it is quite wrong. He does not say what provision was made for flushing it. Mr. Ball-Hill very rightly said that when he is asked what are the minimum gradients he adopts, it is quite impossible for him to say. It depends on the conditions. But possibly for our information he might tell us what are the actual minimum gradients that he has adopted and what precautions he has taken to keep the sewers clean. It is a very important matter because in towns like Calcutta and Madras and all those flat towns, with a high subsoil water level, it is essential to adopt the very flattest gradients you can. Then you can take special precautions to keep them clean. In my opinion it is very difficult to keep any sewer clean in India unless special measures are taken.

Mr. Ball-Hill.—"I would like to say with regard to the first observation that it would be hardly wise, I think, for us to adopt as summits only such sewers which men could get into. The principle of a sewer—of course in a water carriage system—is that you should adopt as small a size of pipe as possible consistent with the area which is drained, so that you can get as high a self-cleansing velocity as possible to clean the sewer from silt. For these 24-inch sewers this principle has certainly not been adopted. There are only a few

houses draining into them and the quantity of drainage is so small that at their gradients—I think 1 in 500—there would be practically no velocity and the only thing such sewers can do is to gradually silt up. The principle of flushing that we adopt is to flush the sewer with a 5 minutes discharge and of course for a 24-inch sewer that means a vast quantity of water. However, in the case of these 24" sewers we only do this very occasionally and they are large enough for men to get through and clean out the silt.

With regard to the gradients in the suburban area, the velocity which we have adopted there is that the sewer should discharge at the rate of 2½ feet per second flowing full. The proportion of rainfall to sewage is 2 to 1, that is dividing the discharge into three parts, there is one part sewage and two parts rainfall. With this the maximum average sewage flow will give a velocity of 2¼ feet per second.

It is remarkable that in the suburban area sewers there is very little cleaning necessary. In the town areas where the sewers are surcharged a large staff of *dhangars* have to be employed in cleaning out the sewers. But in district IV, the suburbs, there is a comparatively small staff and they have to give their attention chiefly to these low gradient sewers to which I have just referred.

With regard to the silt, we adopt the ordinary roadside gullies for intercepting it.

They are about 4 feet long, 2 feet wide by 4 feet deep and the outlet consists of a cast-iron bent pipe with a flap on the bend. It is after the fashion of Doulton's syphon, but the flap can be opened in the case of any blockage in order to clear the obstruction. Of course, during storms a great quantity of silt passes through these gullies.

At each pumping station we have silt pits about 100 feet long which are depressed below the invert of the sewer from 2 to 3 feet—and are the same width as the sewers. So that any silt passing through towards the pumps is collected in the silt pits.

The silt pits are in duplicate and are provided with sluice gates at each end, so that when silt is required to be removed one silt pit is shut off, the sewage is drawn off by the pumps, and the silt dug out. It is lifted by buckets and an ordinary hand crane to the surface and conveyed away to lowlands. Our pumps at the pumping stations are all of the centrifugal type and the sumps are protected by wrought-iron bar screens with the bars spaced an inch and-a-half apart.

There is no doubt that these centrifugal pumps are low in efficiency, but they save a great deal of trouble. The suction pipes never get blocked with silt though much of it is drawn through the pumps. There are no leathers to renew and you can get an enormous quantity of rags as well as silt through the pumps. A certain amount of grinding action takes place between the casing and impeller, but we have adjustable rings to take this up. We are now using cast-iron rings instead of phosphor-bronze or other metal, because we find them durable and cheapest. These rings are adjusted when we find any considerable wear has taken place in the pumps.

So that after all we do not lose a great deal of efficiency in these centrifugal pumps owing to wearing."

Mr. West.—"The gradient of these sewers of 24 inches, he tells us, is 1 in 500, and Mr. Ball-Hill suggests that a 6 or 9-inch pipe would probably be more satisfactory. I would like to know how he proposes to clean a 6 or 9-inch pipe, how he would get a flushing velocity for it at a gradient of 1 in 500."

Mr. Ball-Hill.—"I would like to say in reply that I quite see my friend's point. I had nothing to do with the designing of this part of the scheme. The 24-inch sewers were put in when the project was originally designed. The mistake was in the design. Had the

designer considered the matter, the outfall at the pumping station should have been lower to allow for the necessary gradient and for the smaller size of the pipes at the summit. Probably had I designed it, the sump at the pumping station would have been lower. As it is, I can only assume the conditions under which they were put in, *viz.*, that the designer finding a certain gradient between the main and the point he had to reach with the sewer, put in that sewer to suit it without thinking whether there was a sufficient quantity of water to run it full or half full with a self-cleaning velocity. In a case like this, for an ideal system, the only remedy is to put in a pumping station where these branches join the main and substitute 6 inch or 9 inch or other suitable pipes at proper gradients."

PRESIDENT.—The next paper is "The disposal of sewage sludge," by Mr. Aikman. As Mr. Aikman is not here, Mr. Montgomery has kindly offered to introduce it.

The following is a summary of the paper :—

"It is not unlikely that in the near future the sweeper caste will become less numerous, and for this and economic reasons, compel Indian municipalities to face the difficult engineering problems of removal of sewage by the water carriage system, and the methods of final disposal of sewage sludge.

Where the discharge is not into the sea or large river, some form of artificial purification and disposal of sludge is a necessity. The author reviews briefly the various attempts made in England to solve the problem and describes Dr. Debdin's system of slate beds as suitable for small towns of 10 to 15 thousand inhabitants.

For larger towns of 150,000 inhabitants or more, the latest system, recently worked out and adopted by the Oldham Corporation, is that invented by Dr. Grossmann, Chemical Engineer, Manchester. A description of the system is given in Dr. Grossmann's own words.

The Oldham sludge disposal plant is described by the author who finally concludes that this method as a whole, is, without doubt, the best yet devised."

MR. MONTGOMERY.—"I introduce this paper with great diffidence because I only got it a few days ago, and we all know Mr. Aikman is a gentleman of vast experience in sanitary matters. And I hesitate very much to criticize what he says as I am only a beginner. The gist of the whole thing is that Mr. Aikman on page 2, section 2, condemns wholesale the use of septic tanks. He says that the septic tank process has now been abandoned. I will return to that later.

The next point is that the latter portion of this paper is a copy of what Dr. Grossmann, its inventor, has said and who is working it in Oldham. Mr. Aikman I do not think has seen this system in actual progress, and so we must just take what the inventor says concerning its relative advantages. Mr. Grossmann proves in his letter that by his system, which consists in removing sludge into furnaces and drying the sludge in the furnaces and then re-drying the sludge in retorts by super-heated steam, you get out of the final retort this purified sludge which Mr. Aikman gave me a sample of to-day. I will bring it to-morrow. He gave me a tin of the grease which can be sold at £10 a ton. It looks like boot dubbin, but it is mentioned as being valued at £10 a ton. The inventor's claim is that this is the very thing needed and the result—a very fine powder the colour of coffee - is of a very high manurial value.

To turn back again to the top of page 2, Mr. Aikman says that the septic tank has been abandoned. So far as I know, that is not the case. I don't think septic tanks have been absolutely thrown out We all know that they are not as perfect in the automatic disposal of sludge as they were originally supposed to be. At the same time

they are in use, at any rate I have put them in for Viceregal Lodge at Delhi. The septic action there may not be very strong. But we have never had any complaints of their working there and I should think that was a fairly good test.

I am sure there are many other places in India where they are used, and I should be very glad if delegates could reassure me."

Mr. P. R Hewlett.—"With regard to what Mr. Montgomery said about septic tanks, we have working at Nagpore a very large latrine with 48 seats. This has proved very satisfactory, although the effluent water is not quite clear. The state in which it comes down is so high that when it is led into the drain it shows no sign of pollution. Dr. Ray, the chief officer of the municipality there, was examining it the other day and he did not know that the effluent was going into the drains; but that is not septic action."

Mr. Kent.—"I think I can vouch for the efficiency of septic tanks. I have had a certain amount of experience of them. But there is one excellent example of septic tanks in Bombay at the Leper Asylum.

I think people go there from all parts to see it. It was started originally, I think, by Mr. Corkett James who is now the Drainage Engineer of Cairo, Egypt.

One rather important improvement which was made two years ago was the covering in of these tanks in order to capture the gas which was led away into gasometers and the gas was purified and used on the premises for lighting and the surplus for driving a small gas engine for raising the effluent."

Mr. Salkield.—"I don't think there can be any doubt with regard to the efficiency of septic tanks. But this paper is not about the action of septic tanks—it is about the disposal of the sludge Those of us who know anything about such tanks, know full well that even in the best tanks there is a certain amount of sludge and there comes a time sooner or later—it may be later—when the sludge has to be disposed of, and this paper is really an attempt at the solution of the sludge disposal problem."

Mr. Hewlett.—"With regard to the sludge having to be dealt with if all silt is kept out. I can state I know one tank that has been working 14 years in Benares; it has never been cleaned which shows that there is a very small amount of deposit. I believe it is used by over a thousand people a day."

Mr. Madeley.—"Well, perhaps you have had a sufficient number of people vouching for the septic tank. But I also can vouch for it. From the context I gather Mr. Aikman means that it has been abandoned generally in Europe and elsewhere. I was over the Birmingham sewage works recently and there they have got the septic tank as a preliminary treatment. For large country-houses in England I have myself put in several septic tanks and they have been perfectly successful. In Madras we have septic tanks dealing with sewage mills and we have also put one in for a small hospital, and both these have been thoroughly successful. And some other private people are copying our hospital tanks; after inspecting the tanks they are satisfied. I think, there is no doubt that it is a satisfactory method of dealing with the sewage. With reference to this particular method of disposal of the sludge described in the paper, it is useful to know that it exists. But its success financially depends on the nature of the sewage. It is the fatty matter that prevents the disposal of sewage in England in a way in which it can be disposed of here, because it clogs up the pores of the ground In Madras we find that we can dispose of a great deal of sewage on land without any previous treatment. It gives very little trouble indeed. I don't think the sludge problem exists in India to the same extent as it does in Europe because of the absence of this fatty matter."

Mr. Montgomery —"I don't think I have anything to say at all. I am sorry I missed the point in the paper which is, as one gentleman pointed out, about the disposal of sludge. The paper deals with the disposal of the sludge, its drying, etc., and I have no doubt it is a very successful method in England, but I don't think that we can use it here for many years to come."

Mr. C. L. Cox, City Sanitation Engineer, Colombo, who was absent, communicated the following :—"I desire to make a few remarks with reference to the interesting paper by Mr. Aikman dealing with sludge disposal. It may be of interest to note that the Travis two-storey tank erected at Hampton, England, was the forerunner of the Imhoff or Emscher tank which has proved so successful in Germany and is now being extensively adopted in America. Dr. Travis, I believe, acknowledged his indebtedness to the experimental work carried out at Lawrence, America, and commenced as far back as 1899.

Our experience in Colombo has shown that in designing tank plants for treating an oriental sewage, the most important factor to be considered is the eruption and disgorging of suspended solids brought about by the activity of the gasification process in the organic sludge deposit.

It is proposed to overcome this difficulty by converting the existing single storey septic tanks into two-storey tanks and by adopting for future extensions radial flow tanks of the Imhoff type.

I am disposed to doubt the advantages of Dibdin slate beds for dealing with an oriental sewage. Under tropical temperatures anærobic decomposition is so active that the intermittent exposure of deposited organic matter would probably be attended with nuisance, and from a bacteriological or biological standpoint I can conceive no reason for departing from the general principle of fostering the decomposition (anærobic) and oxidation (ærobic) processes in separate compartments and under different conditions.

Major Clemesha's experiments are of interest in this connection.

It is questionable whether there is sufficient grease in an oriental sewage to repay the cost of extraction by the Grossmann process or whether the value of the sludge as a fertilizer can be materially increased by such methods. After sun-drying, the sludge from the Colombo septic tanks is of a light and somewhat friable nature and all seeds appear to have been destroyed. Small quantities have been sold at remunerative rates and have been transported to considerable distances for use as a fertilizer. Results are not yet available and it remains to be seen whether a market can be found for large quantities."

(*b*) *Width of Cart tyres.*

Mr. Salkield then introduced his paper on "Cart wheels and tyres,"* and said : "It is such a long time since cart wheels emerged from the experimental stage that for generations it has been assumed to be impossible to improve on existing designs. To-day we find, however, that everything used by man for conveying him and his possessions from place to place is being critically examined and improvements in means of transit are being constantly made.

The introduction of mechanically propelled vehicles on our roads is leading to new methods of road construction, smoother surfaces, better gradients, and improved cambers are now demanded by those who are able to enjoy the luxury of riding on rubber. As was to be expected, this question of wheels and tyres is about to be seriously considered by the experts of the Road Board at home and I expect we shall soon have a lot of data collected on the subject and issued for our information. Already I learn that the steam road roller, which we have for so long looked upon as incapable of further improvements, is to be built on entirely different lines and provided with three sets of

* Volume III.

rollers or wheels in parallel, instead of two as at present, the idea being that this will prevent the formation of undulations in rolling. We, however, have to deal in this country with a people who are backward in mechanical science, and where money is not available for the construction of roads of sufficient stability to stand up against the disintegrating action of vehicles as described in my paper. Therefore, we must endeavour to find some solution of our present troubles and I can think of none more likely to succeed, than by increasing the diameter of wheels and insisting at the same time on wider tyres for all vehicles engaged in the transportation of heavy merchandise."

MAJOR BEADON—"It is difficult to gauge how far the question of width and diameter of tyres is of general interest, but it would seem from the fact that it has never been subjected to wide discussion that the evils attendant on small wheels and narrow tyres have not protruded themselves before Municipal authorities to any great extent.

As Mr. Salkield has said, we are particularly unfortunate in Delhi in having the streets overrun by the Delhi thela. This vehicle is a low rakish looking craft with flat boards as a flooring—no side piece—and wheels varying in diameter from 18 to 30 inches. The front wheels are much smaller than the back wheels so as to enable it to turn in its own length—a necessity which will be recognised when we consider the narrow streets into which thelas penetrate—and the carriage itself is a low one, so the cartmen are thereby saved the trouble of lifting loads to a height.

You who are engineers know what an average road in an average provincial municipality is like. You know that 90% of them are not real roads; they are just tracks which have been covered with the maximum silting and surface dressing which local finances have been able to permit, and that maximum represents a mileage sum at which a District Engineer in England would scoff. The travellers who visit this land in the cold weather cannot realise how cheaply our roads are made and what abominable misuse they receive. In the circumstances it is not surprising that our roads soon crumble away under an assault, which even the best roads could not stand. The upshot of the whole matter is that we must either spend vast sums on road making, and even then we must relegate carts of the thela tribe to the *kutcha* side tracks, or we must take measures to compel the people to build carts with larger wheels and broader tyres.

The position is that the expert municipal engineers have shown us the damage done to roads: the Health Officers have explained to us the insanitary nuisance of dust, so it is up to the administrators to prevent the damage to the roads.

It may interest you to know the steps which I have taken in Delhi to bring about this latter object. It was obvious that we could not pass any bye legislation which would prevent the thelas from plying, for such would have dislocated trade at once. We have had to move slowly, so a wrinkle has been taken out of Mr. Lloyd George's book, and a beginning has been made by introducing a graduated tax. The ordinary wheel tax in Delhi is 4 annas per wheel per month, that is Rs. 12 per annum for a thela; under the new scale thelas with tyres 3½ inches width and over pay that ordinary tax, but the tax is graduated so that those with tyres which are less than 2 inches in width will pay Rs. 45. And further, there is a surtax of Rs. 5 per annum for every thela which has any wheel less than 30 inches in diameter.

It is early yet to say what the result will be. Of course, the first result was a general strike which lasted only 3 days. We decided to treat the men leniently, and so let them off at half rates (over Rs. 12) for one year, but they clearly understand that this is but a temporary

remission. From reports that I have received I gather that the wheelwrights are making broader and bigger wheels and I feel sure that the owners of these vehicles will soon realise that it is better to pay more for their thela, for a stronger and more lasting thela, than to pay an equal sum to the wheelwright and municipality combined for a small and weaker thela.

If broad tyred carts can be introduced the expenses of the municipality in road repairs will probably not be actually reduced, but the roads and great lengths of them will be kept in much better order. I cannot confidently advise all municipalities which suffer from the presence of an undesirable type of cart tackling the question through the medium of taxation, but I am inclined to think that salvation lies in that direction."

Mr. Salkield.—" I have little to say in addition to what I have already stated. Major Beadon's remarks are very valuable as he has made a thorough study of the subject. I should like, however, at the final meeting of the Conference to put forward a resolution dealing with this matter. We all know that there is practically no public opinion in India, but I should like this subject to be brought forward if only on the side of cruelty to animals. I am so convinced of the terrible cruelty that is inflicted on draught animals, that I think with the strong Hindu societies in existence, it should not be a difficult matter to raise public opinion against the continuation of such cruelties, though we may fail to do so on the ground of damage that is done to the roads by unsuitable types of vehicles."

EVENING LANTERN LECTURES.

AT 9-30 P.M. at the Medical College, popular Lantern Lectures were delivered by Major R. McCarrison and Major S. R. Christophers, I.M.S.

"GOITRE AND CRETINISM."

BY

MAJOR R. McCARRISON, M.D., I.M.S.

IN introducing his subject the lecturer said :—" I venture to think that few of you will realize to what an enormous amount of physical and mental degeneration goitre gives rise; but when I tell you that between 3·5 per cent. of the children of goitrous mothers are physical and mental defects, and that at the present time there can be little less than 3—4 millions of the women of this country suffering from the disease, you will understand the extreme importance of a full and complete knowledge of this malady.

Many of you must have seen in the Hills in India, and in various parts of Europe, those dwarfs—bloated, deaf, dumb and mentally degraded—to whom the old Swiss term of reproach " Cretin " has been applied—these are the offspring of parents who are sufferers from goitre. In the same regions you may have observed others who, though not dwarfed in body, are mentally deficient, idiots, deaf-mutes, or paralytics; upon these also the toxic agent of goitre has impressed its degrading brand. There are few maladies which so stealthily and relentlessly afflict the human race, and which impose upon hundreds of thousands of the children of this land an existence worse than that of the beasts of the field. Those of us who have seen the cretin, paralysed and helpless, its body, it may be covered with scars of wounds and burns it has been powerless to avoid, its only voice the inarticulate cry of the stricken animal, must be stimulated to exercise the fullest powers of our intellect and of our art in the alleviation of a malady so pitiful. It is one of the greatest triumphs of modern medicine that we can relieve and often cure such sufferers, and it is my great hope that soon we may attain to knowledge sufficient to enable the eradication of a disease which carries in its train such a load of affliction.

But though within recent years the sum total of our knowledge has increased a hundred-fold, yet progress is slow, and there is still much to be done—still much which we understand but imperfectly.

Now the time at my disposal is so brief, and there is so much that I would wish you to see, that I propose to do very little talking and to show you as many lantern slides as possible in the hope that thereby I may the better impress upon you the more important points connected with the causation, spread, cure, prevention and consequences of this insidious scourge."

Upwards of seventy excellent lantern slides were thrown on the screen, very fully illustrating the disease in all its aspects. Goitre in rats, guinea-pigs and fish, both naturally and artificially produced, was also briefly described, the author referring to his own researches on the subject.

In conclusion the lecturer said:—"I fear that in my endeavour to impress upon you the main points of our knowledge of these curious maladies I may have somewhat overstepped the time allotted to me. But if I have succeeded in interesting you, I feel sure that you will pardon my desire to diffuse through you such limited knowledge of these diseases, as I have acquired by their study during the past 11 years. Many of you may have opportunities to educate and to instruct the ignorant in the best means at present known to us of avoiding these diseases, and if by your influence you can introduce into goitrous villages improvements in personal hygiene, better systems of sanitation, better conservancy and better water-supplies, you will go far to prevent the spread of those diseases of want, dirt, and degradation, which are a blot upon our civilization."

"MALARIA."

BY

MAJOR S. R. CHRISTOPHERS, M.B., I.M.S.

After a brief mention of some of the landmarks in the history of malaria the lecturer demonstrated by means of coloured drawings and photographs the characters and life-history of the malaria parasite in man and in its cycle of development in the mosquito. This was followed by a description of the mosquito, of "anopheles" and "culex" and of the stages in the life-history of mosquitoes; almost every point in this section of the lecture, even to the emergence of the adult mosquito from the nymphal skin, being illustrated by excellent photographs of the highly magnified living insects. Photographs of the more important Indian *anopheles* and the kind of breeding places they favoured were then shewn, as also pools, etc., which, though apparently excellently adapted for breeding purposes, were, possibly as a result of natural enemies, free from *anopheles*. Photographic illustrations were then given of a number of the natural enemies of mosquitoes, specially interesting ones being an aquatic web-spinning insect and a small fly (*culicoides*) which in its turn sucks the blood of *anopheles*. In connection with the effect of vegetation on malaria was shewn a pool covered with *azolla*, a plant quite common in India, but which it was at one time suggested should be introduced for anti-malarial purposes from Africa.

In the latter part of the lecture Major Christophers, after explaining that recent research on malaria was now in the main directed to the elucidation of the epidemiological laws governing the distribution and prevalence of the disease, gave a brief description of some of the more modern ideas regarding malaria, emphasizing such now well recognised laws as those of "admixture of susceptibles and parasite carriers," and "non-immune immigration," and showed how outbreaks of malaria connected with engineering work and especially with excavation, could now be explained and regarded as due to the action of various vicious cycles concerned not only with the parasite and the mosquito, but with the condition of man himself. The lecture concluded with the projection on the screen of living specimens illustrating the chief stages in the life-history of "culex" and "anopheles."

Both lectures were closely followed throughout by a large and interested audience.

During the interval and after the lectures the President, the Hon'ble Sir Harcourt Butler, was "At Home" to delegates and visitors.

THIRD DAY, WEDNESDAY, 21ST JANUARY.

FULL CONFERENCE.

THE HONOURABLE SURGEON-GENERAL SIR PARDEY LUKIS, K.C.S.I., K.H.S., I.M.S., PRESIDING, delivered the following address :—

GENTLEMEN,

To-day we adopt a procedure which differs from that at the last two Conferences in one important particular. We no longer separate the deliberations of the General Malarial Committee from those of the Sanitary Conference. The need for such separation no longer exists, the malaria committee being now a sub-committee working under the Scientific Advisory Board of the Indian Research Fund Association. To-day therefore I shall not confine my remarks to malaria and kindred subjects : I shall deal with a larger field and refer briefly to activities in various departments of medical research both in India and other countries. It must, however, be clearly understood that what I have just said must not be interpreted as meaning that the Government of India is paying, or intends to pay, less attention than in former years to the prevention and mitigation of malaria. On the contrary, it is clearly recognised that from the point of view of mortality and ill-health, malaria must be admitted to be the greatest of all the scourges of India. That malaria has not been neglected is evidenced by the important statement made on Monday by Sir Harcourt Butler in his presidential address and by the number of medical and engineering papers, directly or indirectly concerned with the prevention and mitigation of this disease, that have been presented for the consideration of the Conference. It is not necessary for me to comment on the contributions relating to methods of silt disposal which have given rise to such interesting discussions. The subject is one more for the engineer than the pathologist, but its importance is very great from the point of view of malariology.

Before proceeding to the discussion of the various problems in connection with malaria, I must say a few words concerning our new "Indian Journal of Medical Research," the appearance of which I foreshadowed in my address at Madras. Three numbers of this journal have now appeared and I think you will all agree that we have no reason to be ashamed either of its literary contents or of the style in which it has been produced, and I feel sure that you will all join with me in expressing to Major Robertson and Captain Norman White our sense of the debt of gratitude we owe them for the enormous amount of time and labour they have devoted to making the journal a success. It is at present vigorous and flourishing, and I take this opportunity of thanking those contributors who have helped to make it what it is. But, gentlemen, take warning by the untimely demise of the ill-fated '*Paludism*' and do not allow our new venture to be starved for want of literary support. Do not be afraid of over-feeding it. Remember, moreover, that short notes on original work are just as welcome as longer articles. Suitable contributions will not be refused and we are prepared, should necessity arise, to issue it more than four times a year. I terminated my last address with an appeal to all the delegates, official and non-official, to band themselves together in order that we might show the world what

the medical profession in India is doing for the benefit of humanity. This appeal I am convinced did not fall upon deaf ears and I merely wish to remind you now that the Journal is a means to this end.

Sir Harcourt Butler has told you that the scheme for anti-malarial measures in Meerut is still under consideration. I am sorry that for this reason I cannot lay before you to-day Major Graham's interesting and valuable report of a malaria survey of Meerut municipality in 1911. One of the most interesting points connected with malaria in Meerut is the complete change that has occurred in the local incidence of that disease between 1878 and 1911. So far back as 1870 the malarial conditions of Meerut, which we are told had formerly been a healthy station, had become so grave that the question of having to abandon it as a cantonment was freely discussed. The monthly mortality sheets show that these conditions continued up till the quinquennium 1878-1882 and that thereafter there was a quick but steady decline, till latterly the typical autumnal rise of mortality has been practically non-existent. From our present knowledge of malaria, and in the absence of any other plausible explanation, we are forced to give the credit for this vast improvement in health to the broad drainage operations undertaken between the years 1875 and 1879, and it may be stated roughly that, for an expenditure of Rs. 1,50,000, certain permanent changes have resulted, owing to which not only has the necessity of abandoning the cantonment been avoided, but there has occurred in the two decennia 1888-1897 and 1898-1907 a saving of approximately 9,000 lives during the months of September, October and November alone, together with a corresponding decrease in sickness and consequent economic gain.

These results are especially gratifying at the present time as indirectly they justify the method of practical malaria surveys which Major Roberston introduced in his reports on malaria in Nagina and Saharanpur in 1909. At that time the generally accepted opinion in India was that in this country any anti-malarial measures based on mosquito-reduction must be doomed to failure as they necessitated a thoroughness in abolishing all collections of water which for financial and other reasons placed them outside the bounds of practical politics. Robertson, too, regarded this as a counsel of perfection, and after studying the habits of the malaria-carrying mosquitoes he arrived at the conclusion that it might be possible in practice to neglect the less important and more temporary sources of danger and yet attain a considerable degree of success, if careful preliminary surveys were made to find out definitely and accurately the chief danger points. These might then be dealt with thoroughly in ways which would be independent of any help or co-operation on the part of the general public. With such a scheme it seemed reasonable to expect that, even if complete abolition of the disease were impracticable, a marked and permanent decrease in malarial prevalence might be attained at a moderate cost. It was on these lines that he surveyed and drew up his reports on Nagina and Saharanpur. His recommendations were accepted by Government, funds were allotted and the work has been started. In both places the schemes rest on a theoretical basis and can only be regarded as experiments, the results of which cannot be determined for some years. The confirmation, afforded by these Meerut statistics, of the soundness of the method introduced by Major Robertson is, therefore, very important and comes at a most opportune time.

The first paper on the subject of malaria to which I wish to allude is the contribution relating to the incidence of enlarged spleen among school-children in London for which we have to thank Sir Ronald Ross and Majors Christophers and Perry. Its chief interest and importance is in view of the fact that an estimation of the spleen-index of children is the most readily applicable measure we possess for measuring the intensity of malaria in a given locality. We can now continue to use this method of measuring malaria with increased confidence in its value

and fewer doubts as to its validity, except perhaps in districts where kala-azar is prevalent.

I now turn to a question of very great importance, and one upon which there is extreme diversity of opinion—I allude to jungle clearing. You will remember that I told you last year that the Indian Research Fund proposed to allot to Bengal a considerable sum of money for the purpose of carrying out an extensive experiment of jungle clearing in the vicinity of inhabited areas. I regret extremely that there has been considerable delay in starting this experiment, owing to the fact that the Provincial Malarial Committee of Bengal do not consider that the evidence put forward by us of the connection between jungle and malaria has borne the test of further investigation. They state that the only parallel to the Malay experiments that could exist in Bengal is the clearing of virgin jungle such as is now going on in the Sunderbunds, which is not a malarious region. They are moreover of opinion that extensive jungle clearing in Bengal villages is impracticable. It appears to me that this decision is due to a misapprehension of the intentions of the Scientific Advisory Board. The Provincial Committee, acting upon the reports of Major Fry and Dr. Bentley, take the term "jungle" to mean all vegetation, including fruit trees and bamboos. I need hardly say that we never intended any such wholesale destruction of valuable property; all we aimed at was the eradication of rank undergrowth and scrub and useless trees. The condition of affairs round a Bengal village was ably described by Buchanan one hundred years ago as quoted by Bentley himself in the November number of the *Indian Medical Record*. He says: "The great variety of lofty flower and fruit-bearing trees and the luxuriant bamboos by which the cottages are shaded would render their situation delightful, did not rank weeds and bushes, which shoot up with increasing vigour in every corner that is not in constant cultivation, prevent all circulation of air, preserve a constant damp noisome vapour and harbour a great variety of loathsome and pernicious animals." This is the condition we want to remedy. Dr. Bentley, in the last paragraph of his able paper 'On the reaction of mosquitoes to artificial light,' alludes to the generally accepted theory that a screen of trees is beneficial as a protection against malaria and mosquitoes. The question here, however, is not one of a screen of trees; it concerns the eradication of scrub or undergrowth. We have moreover in Major Marjoribanks' suggestive paper on 'Malaria in the Island of Salsette' striking evidence of the deleterious effect of jungle around the village site. He shows that it is possible to map out a series of '*isosplens*'; that the most malarious villages are those at the foot of the hills where the jungle is densest and that the malarial endemicity steadily decreases as you go farther and farther from the jungle belt. To explain this, he advances the very plausible theory that the scrub and jungle afford shelter and humidity to the female mosquito, thus enabling her to live on into the dry season and increasing the period of her infectivity towards man. Major O'Gorman Lalor too in his recently published report on 'Malaria in the Katha district' advocates as a measure of practical utility the cutting down and burning of all scrub jungle twice yearly in and for a radius of one mile around every malaria-stricken centre of population.

Here then you have two entirely divergent views—a further proof, if any were wanting, of the impossibility of framing a general sanitary policy for all India. I trust therefore that this important question will be fully discussed in order that we may arrive at some definite conclusion and then, if the Bengal Malarial Committee still consider that jungle clearing is impracticable, we might suggest that it be carried out either in the Island of Salsette or in some selected district of Burma or Madras, and that the Bengal Committee be asked to suggest some other anti-malarial experiment which is suitable to their Province.

Another matter upon which we require further information, and which formed the subject of one of our resolutions last year, is as regards the precise conditions under which wet cultivation is, or is not, likely to be harmful from the point of view of malaria. So far, with the exception of a brief allusion in Major Marjoribanks' paper, no reports on this subject have reached us, though we trust that Captain Hodson, who is now on special malarial duty in Madras, may have something to tell us next year.

I will now pass on to a report on certain important observations which has been published by Wade-Brown in the Journal of Experimental Medicine for July last. In this article the author, after referring to his previous experimental work on hæmatin intoxication in the rabbit, produces evidence to prove that the anæmia, the hæmoglobinæmia, the high percentage of large mononuclear leucocytes, the destruction of platelets and the tendency to hæmorrhage in malaria are all influenced by the malarial pigment "hæmatin." He gives it as his opinion that hæmatin is probably the hitherto unknown circulating toxin to which malarial anæmia has been attributed, and he points out that the hæmoglobin, converted to hæmatin by the malarial parasite, is not readily available for the regeneration of the red cells, and the blood is thus rapidly depleted of hæmoglobin and iron. In a later report Wade-Brown deals with the renal complications in hæmatin intoxication, but his investigations throw no light on the problem of hæmoglobinuria.

This brings me to the subject of blackwater fever about which there is still considerable diversity of opinion. All the most recent work appears to endorse the opinion that without malaria there is no blackwater fever; but it is still by no means certain that they stand towards one another in the relation of cause and effect. Last year I referred to Leishman's cell inclusions and the suggestion that they might be of the nature of Chlamydozoa. Notwithstanding the fact that Balfour and most other observers are disposed to doubt the parasitic nature of these inclusions or that they play any part in the causation of blackwater fever, Leishman still inclines to his original view. In a recent article on the etiology of blackwater fever he discusses the usually accepted hypotheses as to its causation and admits that there is at present no actual proof of the existence of a specific virus. He argues, however, that the chlamydozoal hypothesis is not inconsistent with well-established points. Thus the association of blackwater fever with malaria is comprehensible if it is assumed that the chlamydozoal virus is transmitted either by mosquitoes or by some different insect whose geographical distribution is similar, and he points out that mosquitoes transmit at least four diseases, two of which (yellow fever and dengue) are due to filter-passing viruses. He urges, moreover, that neither the immunity of natives in endemic areas nor the fact that immunity to malaria appears to go hand in hand with that of blackwater fever can be regarded as being inconsistent with the new hypothesis; whereas, on the other hand, the well-known discrepancies in the geographical distribution of the two diseases may be explained by assuming that some insect, resembling the mosquito in its life habits, transmits the specific virus and that, in those intensely malarious regions in which blackwater fever does not occur, this insect may be either less numerous or not so widely distributed. In conclusion he suggests another possible connection between malaria and blackwater fever, namely, the possibility of the malarial parasite being itself subject to disease. Another theory worth remembering is a suggestion put forward by Balfour that blackwater fever may be caused by the injection of a highly virulent hæmolysin by some insect.

Turning to the subject of the *Spirochætoses*, I must call your attention to Major Bisset's paper on "Relapsing fever in the Meerut district," in which he confirms Mackie's original discovery that *P. vestimentorum*

is the carrier of the disease and also Nicolle's observation that relapsing fever is transmitted by the accidental crushing of the lice during scratching, the mere bite being innocuous. He is however inclined to the belief that infection is transmitted, not so much as the result of actual scratching, but that it is due to the prevalent habit of killing a louse by crushing it between the finger nails. As regards preventive measures, he points out that there must be an active crusade against lice and that the present method of killing them must be discouraged. The importance of the crusade against lice is emphasised by Major McKechnie's report on his investigation into a mysterious fever occurring at Bhim Tal. This fever he believes to be true typhus, the carrier of which Nicolle suspects to be *Pediculus vestimentorum*, though Patton, Husband and McWalters incriminate *Cimex lectularius*, at any rate so far as Indian jails are concerned. Captain Brown, who has also investigated relapsing fever in the Meerut district, confirms Bisset's findings both as regards lice and the ease with which they may be killed by the exposure of clothes and bedding to direct sunlight. He suggests, however, that the possibility of conveyance of infection by *Bragada picta*, one of the harvest bugs, is deserving of investigation. It is obvious that we must not regard *P. vestimentorum* as the only carrier of spirillar fevers in India. Last year I mentioned an outbreak of an abnormal type of relapsing fever in Quetta which Browse considered to be transmitted by *Argas persicus*. Since then Jukes has reported cases of spirillar fever occurring in the Darjeeling district, in which the temperature is irregular and shows no resemblance to that of relapsing fever. In all these cases jaundice was a marked symptom and there was a high rate of mortality. Jukes is inclined to regard the fever as hitherto undescribed, but in my opinion it is identical with the biliary remittent fever of Vandyke Carter. This, however, is merely an academic question : the important point is that lice and bugs from the infected houses were dissected and in no instance were spirochætes found in these insects.

In this connection I must mention that during the past three or four years a peculiar fever, accompanied by jaundice, has been noticed in the Andaman Islands. The jaundice, which appears on the third or fourth day, is often intense and in severe cases there are petechial hæmorrhages, bleeding from the gums and delirium. The mortality is 40 per cent. Hitherto this fever has been regarded as malarial, but no malarial parasites are found in the blood, and treatment by quinine is of no avail. Major Woolley thinks this fever may be classed as a separate entity. I suggest that it may possibly be spirillar.

Our knowledge of kala-azar has not advanced to any great extent during the year, but you have before you an important communication from Rogers, dealing with measures taken to stamp out the disease in Assam. An interesting paper on the Mediterranean variety of the disease by Laveran and Nicolle was read in the Tropical Medicine section at the recent International Medical Congress. In this paper the authors maintain that the differences formerly invoked as existing between the Mediterranean and Indian forms of the disease tend more and more to disappear and that in all probability the identity of the two will soon be established. In support of this view they instance the recent work of Row at Bombay, the successful inoculation of a dog by Donovan at Madras, and the fact that the alleged difference as regards the age incidence is now known to be non-existent. We must admit that the differences formerly insisted upon are rapidly disappearing. Row has proved that we cannot rely upon the cultural differences in the behaviour of the two types of parasites, and Mackie's report on 'Kala-Azar in Assam' brings out the interesting fact that 50 per cent. of the cases occur between the ages of 6 and 10, and 81 per cent. during the first fifteen years of life. But when we come to the question of the dog as a reservoir of infection, difficulties at once arise. It is true that Patton has confirmed Donovan's results and has successfully inoculated dogs, so that we can no

longer regard them as immune. On the other hand, between November 6th, 1912, and May 16th, 1913, acting on the suggestion made by me at the last Conference, he has examined both the spleen and bone marrow of 1,321 dogs destroyed in the lethal chamber at Madras, and in no case was a dog found to be naturally infected with Leishmania. It is evident, therefore, that, in the endemic centres of kala-azar in India, dogs are not infected as they are on the Mediterranean littoral. We have, moreover, the evidence of Mackie that the main point of epidemiological interest in the disease is its dependence upon *close personal contact.*

I must now say a few words on the subject of anti-stegomyia campaigns. The President has told you that during the last year Major James has been carrying out an active and successful anti-stegomyia campaign in Colombo, and we had hoped that he would have given us a paper on the subject. His unfortunate illness has prevented him from doing so, but I have certain information on the subject which may be of interest. I understand that the campaign was carried out in the heart of the business section of the city which was only separated by the width of several streets from similar sections in which no operations were undertaken. I am told, moreover, that the operations were incomplete owing to the fact that it was impossible to deal with certain important breeding places such as roof gutters and water-storage cisterns. Notwithstanding these drawbacks, in the course of six investigations made at intervals of five days, it was possible to reduce the potential breeding places by 60 per cent. and the actual breeding places were reduced from 275 to 4. Moreover, a series of test breeding experiments showed that, whereas before the campaign was undertaken this section of the city contained more stegomyia than any other portion, after the operations were completed, the percentage of pots placed within the area which became infected was 12·1, whereas it was 17·1 in pots placed outside it. These are very promising results and show what we may hope to attain when we have a constant water-supply in our seaports and the power to deal with roof gutters, water cisterns, storage tanks, etc.

I now turn to what is being done in India. The Government of Bengal has recently had under consideration Major McGilchrist's report on the prevalence of stegomyia in Calcutta, together with a note on the same by the Sanitary Commissioner of Bengal, in which he advocates the prosecution of a systematic investigation of the stegomyia problem in typical areas of Calcutta. The Governor in Council is prepared to accept these suggestions and proposes to ask the Sanitary Commissioner to draw up a suitable scheme. In the light, moreover, of the conclusions arrived at in the recent investigations, the necessity of securing throughout the twenty-four hours a high pressure service from the new reservoir at Talla is being impressed upon the Corporation, and the question of the control of reservoirs, cisterns, etc., is under consideration in connection with the amendment of the Calcutta Municipal Act, No. III of 1899. In this connection the conditions prevailing at Chittagong will also be the subject of investigation, and the question of the improvement of the water-supply of this port is engaging the attention of the Local Government.

The next point I must mention is that of the relationship of *Stegomyia scutellaris* to yellow fever. Is it or is it not a carrier, and, if not, is there anything in the suggestion that *S. scutellaris*, by driving out the allied species *S. fasciata*, may protect a given locality from infection? To settle these points it was originally suggested that eggs of *S. scutellaris* should be sent to West Africa, but objections were raised to this proposal. I am glad to be able to tell you, therefore, that I have recently received a letter from Dr. S. T. Darling, the Director of the Board of Health Laboratory at Ancon, asking me to send him eggs and that I have made arrangements to comply with his request. His report on the carrier question will be awaited with interest, but Indian experience teaches us that there is little likelihood that *S. scutellaris* will ever drive out *S. fasciata*. The

two species live side by side in perfect amity but they differ widely in their habits. *S. scutellaris* prefers rural to urban life and is usually found in or near gardens. In fact, as McGilchrist points out, it is a tree-loving mosquito and is often found breeding hundreds of yards from inhabited houses, whereas *S. fasciata* never breeds more than twenty yards away. *S. fasciata*, moreover, has a predilection for human blood, whilst *S. scutellaris* is indifferent whether it obtains its feed of blood from man or from other animals.

Whilst in London last summer I was consulted on various points by the West African Yellow Fever Commission. They consider it desirable that, in view of the possible advent of yellow fever, we should make an investigation into the etiology of the fevers of short duration, much on the lines suggested in my address at Madras. They also require certain clinical information as regards the association of jaundice, slow pulse, and albuminuria with these diseases. We are already carrying out isolated investigations on these points, but we now propose to depute a whole-time officer for this special inquiry as part of our research programme for the coming year, and we hope that we shall be able to secure the services of Major McCarrison, with whose work on three-day fever you are all acquainted.

As regards the carrier in these cases, I note that Legendre has suggested that possibly *S. fasciata*, and not *C. fatigans*, may be the most important carrier in dengue. This is in accord with the observations made last year by Major Lalor as regards the carrier of seven-day fever in Rangoon.

We now come to the subject of water-borne diseases. Major Grieg has continued his researches into cholera and can be congratulated on some valuable results. His papers have been published in the Journal and I wish to draw your attention to two of them which deal with original research carried out subsequent to our last Congress. The paper in the October number on 'The precipitation of bacterial protein' shows that this method will be of assistance as a supplement to other tests in the differentiation of cholera from cholera-like vibrios. The report in the January number on 'The life of the cholera vibrio outside the human body' is now before the Conference for discussion. All Grieg's observations demonstrate the importance of the human factor, and teach us that, as in the case of enteric fever, we can no longer regard cholera merely as a water-borne disease, while his successful cultivation of the cholera vibrio from the lung shows us that the disease is a true septicæmia.

You have doubtless heard that it was the intention of the International Bureau of Public Health of Paris to send a Cholera Commission to India to study various points in connection with the epidemiology and treatment of that disease. I had two interviews in London with Sir Benjamin Franklin and Dr. Amand Ruffer, when I pointed out to them that practically all the points covered by their terms of reference were now under investigation, and that the Government of India was prepared to place another officer on special duty to test the effects of the various anti-cholera sera. It has been decided therefore to postpone the visit of the Commission until next winter. If our investigations proceed as satisfactorily as they have begun, I think it possible that by then there will be little left to discover.

Captain Cunningham has not yet submitted any report on his dysentery investigations so that this subject cannot be discussed, but an excellent paper by Rogers in the October number of the Journal on 'The bactericidal action of organic silver salts and other antiseptics on the dysentery bacillus' is deserving of attention.

An excellent example of the dangers of fæcal pollution of water is afforded by the results of the investigation into the causation of goitre which has been conducted at the Central Research Institute, Kasauli, by Major McCarrison during the past year. These investigations will, I

trust, result in a marked diminution in the number of cases of goitre amongst the pupils of the Lawrence Military Asylum at Sanawar. His two reports are published in the January number of the Journal and are well worth your careful perusal. Under the head of water-borne diseases, I must mention also the admirable piece of original work done by Dr. Turkhud in connection with dracontiasis.

The President has already alluded to three of the papers on plague. No further remarks from me therefore are necessary. I wish, however, to call your attention to certain observations of Captain Norman White which, although they are not before the Conference, have an important bearing on the problem of rat destruction. Briefly stated, his observations were as follows :—In Lucknow during the hot weather of 1911 he noted the fact that most of the young rats were females and on studying the phenomenon closely he found that there had been some adverse influence at work destroying adult females. This was certainly not plague. The process went on and, to compensate for it, during nearly two months only females appeared to be born. This observation raises a point of considerable practical importance in connection with plague preventive measures. It has been urged that the most efficacious method of diminishing the rat population in a given area is to catch rats, liberate the males and destroy the females, and it is said that by so doing, breeding is markedly diminished and the young ones that are born are increasingly liable to be eaten by the proportionately increased male rats. The ease and rapidity with which the balance of the two sexes was readjusted in Lucknow indicates that any such measures of rat destruction are not likely to meet with success, at any rate so far as *Mus rattus* is concerned. I must also allude to an admirable piece of original work brought before the Tropical section of the International Medical Congress by C. J. Martin, which does not appear to me to have received the attention it deserves. This work was undertaken with a view to discovering the method by which the plague bacillus is conveyed from rat to man by the rat flea. The generally accepted view is that it is conveyed as the result of fæcal contamination of the puncture and not by the actual bite. Martin has shown that this view is incorrect and that as a matter of fact it is only diseased fleas which convey the infection to man. The mechanism by which this is brought about is as follows :—In a certain proportion of fleas the proventriculus becomes absolutely occluded by a pure culture of plague bacilli. As a result of this no fluid can enter the stomach, and the œsophagus, which normally is represented by a thin red line, becomes enormously distended until it arrives nearly at the bursting point. When this happens, all the ingested blood, and with it plague bacilli, is regurgitated, thus infecting the small wound made by the bite of the flea. Martin suggests that this pathological condition of the infectious fleas may account for the rapid disappearance of plague when the hot dry weather sets in, and he points out that the diseased fleas, owing to the fact that they cannot imbibe any fluid into their bodies, are likely to dessicate extremely rapidly under such conditions, leaving only the healthy fleas which are incapable of infecting human beings. This, I think you will agree, throws a very interesting sidelight on the manner in which changes of temperature and humidity may influence the course of an epidemic ; and it is of special importance in connection with Major Greig's observations on the factors influencing the life of the cholera vibrio outside the human body.

I fear, gentlemen, I may have wearied you with this long dissertation. The importance of my subject and the keen interest which I take in all branches of medical research must be my excuse.

SECTION A.

First Session.

The Hon'ble Sir Pardey Lukis, K.C.S.I., K.H.S., I.M.S., Presiding.

(a) *Malaria.*

The President: —We will first introduce the papers and then have a general discussion at the end. The first paper* is by Dr. de Mello which Captain Norman White will introduce.

Captain Norman White :—I had the honour of translating this paper by Dr. de Mello. It is one of considerable interest, though Dr. de Mello tells us that practically nothing so far has been done towards the elucidation of any of the problems of malaria in Goa, although many parts of Goa are extremely malarious, more especially the *Novas Conquistas*. In the capital of Portuguese India the species of anopheles that is most frequently found is *Nyssomysomia rossii*; *A. stephensi* occurs, but is rare.

The author describes the diminution of malaria in the *Velhas Conquistas* and attributes it to the therapeutic treatment of malaria carried out by the Doctors of the "Ecole de Nova Goa." After having described the clinical aspect of malaria as seen in the Military Hospital, the author states that malaria is about to receive the special attention of the Government: that a Malaria Bureau is to be created to study the various problems connected with malaria in Portuguese India, and that malaria prophylaxis is to be carried out in accordance with the decree of the 14th March, 1913, of which a translation is produced.

Perhaps the most interesting and valuable part of the paper consists of the recommendations which it is hoped will be carried out in Goa in the very near future. They are particularly interesting because they seem to be aimed as much against *stegomyia* as against anophelines, and, from the point of view of yellow fever, it would be difficult to improve on them.

The paper has been in your hands for some time and I do not think I need say anything more about it by way of introduction.

Sir Pardey Lukis :—The next paper* deals with the spleen rate of London school children by Sir Ronald Ross, and Majors Christophers and Perry, I.M.S., and will be taken as read.

The following is a summary of the paper :—

The authors, on a question arising out of the examination by one of them of the children in Cyprus for enlarged spleen, have examined about 500 children in schools in the north of London where any effect due to malaria can be absolutely excluded. The special object of the enquiry was to ascertain in what proportion of cases, in a very careful examination, the normal spleen could be detected by palpation. In the children examined the spleen was detected in only one per cent., whilst a maximum of two per cent. included all doubtful cases. Any error, therefore, due to the normal spleen being found "palpable" and being considered as "enlarged" can be neglected in taking spleen rates, and any considerable proportion of "just palpable" spleens must be considered pathological.

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Incidentally a spleen rate in these children of only one per cent. must have been due to causes other than malaria. None of the spleens found palpable were much enlarged. The authors consider that a change in consistence, as well as increase in size, is an important character of an enlarged malarial spleen.

CAPTAIN C. A. GILL introducing his paper on "The value of the parasite rate in the measurement of Malaria"* said the paper itself calls for little comment; the chief point I desire to emphasize is the fact that benign and sub-tertian malaria show a marked variation in their seasonal prevalence. This is well shown in the chart, where it is seen that benign tertian parasites are most prevalent in the spring and early summer, whilst the malignant tertian parasite—or, as the Italians call it, the æstivo-autumnal parasite—is chiefly prevalent in the autumn. This observation is of some importance at any rate to those who are engaged in making malaria surveys.

It shows that :—

(1) the total parasite-rate is subject to marked seasonal variations;

(2) the relative prevalence of the various species of parasite will alter according to the season of the year when the blood examination is made.

Finally it may be noted that the sub-tertian parasite is chiefly prevalent in the autumn—and that this is the period when in the Punjab we get periodically those great epidemics which Christophers has called *fulminant*. This subject will be dealt with fully when a paper, now under preparation, on the subject of the mechanism of fulminant malaria, is published.

CAPTAIN E. C. HODGSON then put in the following note on "The internal temperature of the mosquito," by himself and Captain H. H. King. Most people have considered the internal temperature of the mosquito to be that of the atmosphere. We consider it to be that *of the wet bulb of the hygrometer*, and to vary with that.

Taking the mosquito in its larval existence we found that the optimum temperature for anopheles lay between 68°-78°F.

Temperatures above 80°F. became more and more unsuitable, while temperatures of 95° to 104°F. were rapidly fatal.

In nature, during the monsoon at Delhi in August, and in Madras in November, we found the surface of pools to vary from 73°F. to 104°F., the differences being due to the following important facts:—

(1) The *coolest* pools were very small pools lying amongst grass.
(2) The edge of a pool in the day time is cooler than the centre.
(3) The surface layer is often 3° or 4° hotter than the water four or five inches down, at mid-day.
(4) The water lying at the shallow edge, round grass stems, is the coolest part of a pool.
(5) When the average temperature of pools had risen to 90° or even 100°, falling rain both at Delhi and Madras was found to be 73° to 77°F. during the monsoon.
(7) The river at Delhi even after long drought never rose above 87°F., at mid-day.
(8) Well water varied from 80°F. to 82°F.
(9) The sea at Madras in the monsoon was 80°F.
(10) Small hoof marks in grass might contain water 9°F. cooler than a large pool 6 inches away, particularly during hot dry weather.

An anopheles mosquito lays her eggs in that type of pool which is coolest at the time.

The struggle for existence rapidly increases above 80°F. and temperatures such as 104°F. are fatal to every single larva in less than 18

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hours, though this is a temperature at which some pools have been found in nature.

In the Terai in October water varied from 65°F. to 78°F. on the two days we examined it, and anopheles were breeding in millions.

The great destroyer of mosquito larvæ is Nature and her principal means is raising the temperature of the water.

Now as regards the adult mosquito, in our opinion it lives at the temperature of the wet bulb, and its optimum temperature is the same as that of its larva, somewhere about 86°F. to 78°F. We have been unable to obtain direct records of its internal temperature ; we infer it for the following reasons :—

(1) The mosquito shows no signs of being able to regulate its own temperature. On studying its anatomy we find it is a moist animal traversed by innumerable air passages in connection with the outside air. Physicists inform us that this animal must, therefore, live at or near the wet bulb temperature.

(2) We consider we have proved that anopheles larvæ flourish best at the temperature 68° to 78°F. and that temperatures of 100°F. are very rapidly fatal. We consider that it is in the last degree unlikely that the adult should pass its life at a different temperature to its larva, which it would have to do if it lived at atmospheric temperature.

(3) Experimentally, after saturating the atmosphere we found a temperature of 68°F. was the best for keeping adult mosquitoes. Temperatures above this becoming rapidly more and more fatal. Saturation is not inimical to mosquito life, quite the contrary.

From all this and some further incomplete experiments, we deduce that the malarial parasite while in the mosquito lives its sexual cycle at a or about the same temperature as the kala-azar parasite which has been found to grow in vitro at 65°F. to 70°F. Taking daily wet bulb figures at Delhi for twenty years we find those years which suffered most from malaria showed more days in which the temperature ranged between 68°F. to 78°F. wet bulb. For instance, 1908 showed 90 days, 1906 showed 68 days, while the average year had only about 48 days in which favourable temperatures were found. We consider these to be some of the more important factors in the study of malaria and we consider that experimental study of insect carriers should be carried out in saturated atmospheres. We bring incomplete results before you as, owing to our present duties, we have very little time for carrying on experimental work.

Major J. L. Marjoribanks, I.M.S., then introduced his report on "Certain features of malaria in the Island of Salsette."* The following is a summary :—

Salsette is an island on the west coast of India, north of Bombay island, of about 200 square miles in area. It is traversed by a range of hills, the highest peaks of which are 1,500 feet, with spurs running westwards towards the sea. It is separated on the north and east from the mainland by a creek, on the other side of which similar ranges of hills are to be found. The taluka includes a strip of the mainland.

The hills are of volcanic origin, most of the rock being trap. There is a certain amount of sedimentary rock, however, especially in the south. The soil derived from the disintegration of the trap extends from the bases of the hill-scarps down to the sides of the creeks, where it gives place to salty alluvium. There is a heavy growth of trees and grass on the soil, but not on the alluvium.

A specially prepared spleen rate map accompanies the report. Highly marked variations are seen to occur in the intensity of malarious-

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ness, the main obvious factor being proximity to the hills. If lines be drawn connecting places of approximately equal spleen rates, which might be designated *isosplens*, they would be found to be parallel with the lines of the hills on the one hand, and with the coast line on the other, the *isosplens* becoming lower and lower towards the coast. The spleen rates on the slopes of the hills are always well over 50 per cent., those on the flats of the coast are *nil*. Where hills come right down to the sea, intermediate figures are obtained.

Other factors appeared to be the presence of trees and grass, the combination of trees and grass especially seeming to favour a high spleen rate; the accessibility of villages to the sea-breezes gives a low spleen rate.

These several factors are obviously interdependent: thus there is more of trees and grass on the soil of the drainage area of the hills than on the salty alluvium near the sea, and places without trees and grass are the more accessible to the sea-breezes. Villages on creeks with hill ranges on both sides do not show the low spleen rates of coast villages with hills on one side only.

Enquiry into the statistics of the decennium 1901 to 1910 fails to show either an epidemic figure for any particular year, or any progressive increase in the amount of malaria. But the presence of lines of villages, deserted about a generation ago on account of malaria, along the slopes of hills, clearly shows that at one time the country side could not have been nearly so malarious as it now is.

The presence of rice fields does not appear to influence the spleen rate. Nor does the presence of wells containing the larvæ of notorious carriers; these were abundant in places with no spleen rate at all.

MAJOR MARJORIBANKS said: As has already been mentioned to-day, the two points most clearly brought out by the investigation in Salsette are the relation of the spleen rate to the hills and also its relation to a combination of the occurrence of trees and grass. The spleen map is reproduced at the end of the report and the variations of the spleen rate depending on proximity to the hills can be seen at a glance. The remarkable relation of the spleen rate to the hills is brought out particularly in the instances mentioned at the top of page 22 and in the second paragraph on page 23. It is clearly brought out that, given an absence of certain factors, one may have the most notorious carriers of malaria without any spleen rate at all. Thus in Bandra only one child in 1901 had an enlarged spleen, although *Myzomyia culcifacies* and *Myzomyia listoni* were abundant in the wells. This is only a few miles from a place with much the same distribution of mosquitoes, which had a spleen rate of 80 or 90 per cent.

One very depressing feature of the evidence is that it shows that in Salsette malaria is much worse than it used to be a generation or two ago, and this without any change in the physiography of the district. The only change in these two generations has been the building of the two railways which connect Bombay with every part of India, and it is a fair deduction to make that it is by the railways that the infection has originally been carried.

I need not say that the investigation does not claim to have been complete enough to be regarded as a malaria survey. Although I have been able to base practical suggestions for town-planners upon my investigations, these only consist, from a practical point of view, of spade work, to prepare the way for more detailed and localised investigations. These, I hope, will be taken up either by the pathological department of the Grant Medical College or by the Bombay Bacteriological Laboratory, both of which institutions are close to the area in question.

Captain J. H. Horne introduced his paper "Malaria in Wynaad."* The following is a summary :-

The Wynaad is a hilly plateau to the south-west of the Nilgiri Hills, 50 miles long by 20 broad, and 3,000 feet above sea level. Its main physical features are low rounded hills, covered with bamboo jungle or planted with tea, between which swamps and streams occur.

The fever that prevails in Wynaad, though occurring chiefly in the hot weather months, March to May, is undoubtedly malaria. Its cessation with the onset of the monsoon in June is accounted for by the sweeping away of mosquito larvæ by the swoller streams.

Adult anophelines in May and June appeared to be scarce : of these, *M. listoni* was found infected. Anopheline larvæ swarmed : *maculipalis* and *willmori* were the commonest and were breeding in swamps and streams. *M. listoni* was breeding almost entirely in streams. Other possible carriers found were *P. jeyporensis* and *My. barbirostris ;* both were scarce.

In the villages, spleen rates varied from 95 per cent. to 15 per cent., being highest in villages inhabited by aboriginal tribes, and lowest in the villages in south-east Wynaad. The parasite rates were also highest in the former. The commonest type of parasite was benign tertian, then quartan, and lastly malignant tertian.

On the estates, the spleen rate was also high among both children and adults. Some coolies are recruited from malarious areas and most of them leave Wynaad for 2 or 3 months during the hot weather. But the high degree of infection among the permanently resident aborigines and the constancy with which European newcomers are attacked, lead to the conclusion that the source of the malaria is now essentially local.

Captain Horne :—This paper simply deals with the conditions present in the Wynaad, a hilly plateau at the foot of the Nilgiris with a highly malarious reputation.

The points worthy of note are :-

(1) The occurrence of the fever season in the hot weather months previous to the monsoon.

(2) The richness of the mosquito fauna ; twelve species of anophelines were met with, six of which are potential carriers, and one of which (*Myz. listoni*) was found to be an actual carrier.

(3) The intensity of malarial infection among the aboriginal jungle tribes, who from their healthy appearance appear to have developed a high degree of immunity.

Sir Pardey Lukis :—Dr. Macdonald is not here. We will take his paper "On the use of larvicidal fish in combating malaria* " as read.

The following is a summary of the paper :- The value of larvicidal fish as an ally in anti-malarial measures is pointed out, and it is noted that the stocking of tanks and wells with such fish is now being proceeded with in Madras City.

The larvicidal fish usually met with in Madras City are enumerated, the most numerous and voracious being *Haplochilus* (Tamil name *Velichai Kendai*).

The striking results of a vigorous campaign to eradicate malaria are given in the case of the Tamil Mission Orphanage. In the vicinity of this Orphanage are several tanks, and the buildings are surrounded by a deep moat. Myriads of mosquitoes infested the premises. Nearly all the occupants (80) were prostrated with malaria in February 1913. Haplochilus and mosquito larvæ were abundant, the water was carpeted with a dense mass of fresh water algæ.

Trimming of vegetation, removal of weeds and filling up of shallows and hollows was undertaken. The water was petrolised, this being found

* Volume IV.

not to interfere with the fish in any way. Quinine treatment was kept up side by side with the mosquito reduction operations.

This campaign was steadily persevered with, the Principal and older boys of the Orphanage, all co-operating, and in June 1913 there was not a case of active fever and larvæ could not be found. Nor has there been relapse since.

The author points out that, although the stocking of tanks with larvicidal fish cannot replace other anti-malarial measures, such as reclamation, it is a most valuable aid in all cases where permanent works may be barred for financial reasons.

Dr. C. A. Bentley introduced his paper "A suggestion regarding anti-malaria sanitation specially adapted for Bengal."* The following is a summary :-

Attention is called to the fact that the centre even of malarious towns is usually comparatively free of malaria. It is sometimes suggested that few breeding-places for anopheles mosquitoes exist in the centre of towns, or that contamination by sullage of such breeding-places as exist, limits the output of anopheles. But these assumptions do not always appear to hold good ; and the paper indicates another alternative, pointing out that it is almost always in areas where the population is most dense that malaria is least apparent, and suggesting that the static malaria of a community must necessarily be low if the number of anopheles per person is few ; and that a similar result to that which follows a decrease in the absolute number of anopheles in a given area, may also be brought about by an increase of the human population in the area, provided the number of anopheles remain fixed.

This fact may be made use of in combating malaria, especially in the case of Bengal towns which cover a wide area and often resemble an aggregation of hamlets round a central bazaar, with patches of waste land and cultivation on every side. By taking steps to concentrate the scattered populations of such towns, it will be possible to bring about a reduction of malaria as well as to simplify other sanitary improvements, such as provision of water-supply and conservancy systems. Similarly, in rural districts the formation of model townships may be expected to bring about a reduction in malaria and stimulate sanitary reform.

Dr. Bentley said :—This paper was, I may say, prepared some 16 months ago. It may perhaps be a little bit unconventional and may appear to go against a number of our ordinary supposed rules of hygiene ; but I wish to emphasize the fact that it specially applies to conditions in Bengal. Two days ago I had the opportunity of addressing you and pointing out that Bengal differed from almost every other part of India. Three parts of it is a delta. It is not only different physically, but it is different in the character of the people and the way in which they live. In their villages instead of individual houses being huddled together, as in almost all other rural areas in India, they are widely scattered, each house being surrounded with an orchard and garden plot one-third of an acre and sometimes more in size. You may see a municipality of perhaps 15,000 people, like Dinajpur which has a mean density of only 4 people per acre. You may also have a village with only 33 houses in which it will take you a whole day to go from house to house. Under conditions like this, concentration of the population may become a useful measure of anti-malarial sanitation. As Major Marjoribanks has already told us, in places where there is a very dense population, in spite of there being a considerable number of anophelines malaria may be almost non-existent. Before proceeding further, I shall read a paragraph from Ronald Ross's book on the "Prevention of Malaria," that deals with this very question of the relation of the density of population to the intensity of malaria. I may say that

* Volume IV.

I had overlooked this passage and did not find it until after I had written my paper. It will be found on page 194 and runs as follows :—

"(9) *Effect of density of human population.*—Suppose that in a locality the mosquito population remains the same, but that the human population varies : what will be the effect of this variation on the malaria ratio. By the static formula $M = 1 - 40/a$; but a is the number of anophelines, not in unit of space, but *per* unit of human population. If, therefore, the latter is doubled while the total mosquito population remains constant, a will be halved ; and so on. Thus the static malaria ratio tends to decrease with increase of the density of the human population. . . It may happen that when the human population begins to increase the local breeding surface is already yielding its maximum output of mosquitos. In this case the increase of the human population should cause a decrease in the static malaria ratio."

Now I just wish to express what this means. We will take it in relation to the probability of anophelines becoming infected. Supposing in this room we have one anopheline mosquito that is an efficient potential carrier of malaria, and one man who has gametocytes of malaria in his blood. Now the chances are that if that mosquito feeds upon him it may become infected. But if we place 99 non-infected people in the room with him the chances are 100 to 1 that the mosquito will not bite the infected man.

It is this point to which I wish to call your attention. There are a whole host of things which may influence malaria, but I am not discussing that. I am discussing the effect of varying the numbers of human population in an area with a fixed number of anophelines. The point that I have tried to make clear is of the greatest importance to those of us who have to deal with malaria in rural areas, where hitherto the cost of anti-mosquito operations has appeared almost prohibitive. If, on further investigation, my suggestion is found to hold good, it seems to me that we possess the key of the situation, for by judicious concentration of a scattered population, we may increase the effectiveness of anti-mosquito operations to an almost unlimited extent.

Dr. Bose referred to the necessity of educating villagers as to the value of anti-malarial measures, such as jungle-clearing, removal of rank weeds, vegetation, and shrubs.

Dr. de Mello said :—"Il est un peu hardi de ma part de parler devant les maîtres du paludisme, mais je désire appeler votre attention pour ce qui suít.

On a un peu abusé de *spleen rate* comme signe du paludisme, comme on a abusé de *malaria* pour la diagnose de toutes les maladies inconnues. A présent, rate enlargie veut dire paludisme, et dans cet empressement de chercher partout la malaria, les médecins viennent, palpent les flancs, n'accordent aucune attention aux contractions musculaires, aux fausses côtes, aux aponévroses, et souvent tous ces examens précipités pèsent lourdement sur la colomne du paludisme. Je suis très satisfait que les auteurs du *spleen rate*, et qui sont incontestablement des autorités dans cette matiére, viennent nous dire quelques-unes de ces difficultés de technique et nous fassent voir les causes d'erreur jusqu'à present commises.

Dans la délimitation de la rate et des organes en général je me suis fort bien trouvé avec l'usage du phonendoscope de Bianchi, et de son levier, en touchant legèrement avec le doigt l'abdomen, les sons changent d'après son contenu. En résumant je voudrais soumettre à l'apréciation de la Conference les suivantes propositions :—

1. Le *spleen rate* a seulement de la valeur dans un pays d'origine reconnument palustre, pour montrer l'extension de la malaria dans la région, et la chronicité de la maladie chez l'individu.

2. Considirée isolément la *rate enlargie* n'est pas un signe sûr du paludisme, puisqu'il y a des malades chez lesquels un ou deux accès de paludisme ne donnent pas cet enlargissement, et ce signe peut ex-

ister en différentes autres maladies, notamment le kala-azar, la typhoide, et quelques autres affections vermineuses si fréquentes dans les pays chauds.

3. Le médecin qui étudie ce signe doit posseder une technique délicaté et un interpretation très éclairée pour eviter possiblement les causes d'erreur."

Rai Bahadur U. N. Brahmachari said that he could not agree with Dr. Bentley's views of crowding the villagers together in as close proximity as possible.

He thought that if the houses were separated from each other, the chances of infected mosquitoes from an infected house flying to an uninfected house would be much less, and the chances of the healthy people being infected would be much less too. He referred to the observations of Major Christophers and others, that overcrowding was one of the most potent factors in bringing about intense and epidemic malaria, and he could not understand how this very measure could be adapted in Bengal for the mitigation of malaria.

Captain Gill :—Dr. Bentley referring to the interesting observation that congested parts of large towns often show less malaria than the more sparsely populated peripheral portions makes the suggestion that the greater concentration of the population in the central areas diminishes infection by reducing the individual dose. It, however, does not necessarily follow that the centre of towns are invariably more congested than the periphery. In the case of Amritsar, for instance, it is fairly clear that although the centre of the city is intensely congested during the day it is much less so at night, and night is the time that malarial infection is contracted. The central area is the business area, where a large number of persons carry on business and employ a large number of clerks, menials etc., who live in the peripheral area. These being adults are not examined in taking a spleen rate of children. At night these people return to their homes in the peripheral zone. But further a good many of their employers also shut up their shops, banks and premises, and some of these also live in the peripheral zone. So that at night it is possible in Amritsar that the congestion of the city in the centre is very considerably relieved and, therefore, perhaps that the periphery is of the two the more congested. This is only a rough observation but to make my point clear, let us take the case of London, where as everyone knows there is great congestion in the city during the day but at night it is like the city of the dead. It has commonly been said that its only occupants then are a few charwomen, policemen and cats. In regard to the anopheline question my observations in Amritsar show that the mosquito population does not remain constant, and that mosquitoes are much less prevalent in the centre of the city than they are in the periphery. Hence the mosquito factor not remaining constant Sir Ronald Ross's formula does not come in. My explanation of the comparative freedom of the central portion from malaria is that it contains a larger number of the well-to-do who suffer less from malaria than the poorer classes.

Major Christophers :—In regard to what Captain Gill has just said with reference to Amritsar, there is another factor he has not taken into account. The centre of Amritsar consists of quite high buildings, from four to five storeys high, whilst the surrounding areas in which most people live consist of ordinary, low, single or double-storeyed houses. In making a survey of Amritsar some years ago, I used to find that not only did adult anophelines cease practically at the limit of the low houses, but that malaria followed the same distribution. So that my own opinion in regard to Amritsar is that the central area is comparatively free from malaria on account of the protection afforded by very high buildings.

Major Perry :—With regard to the question of the effect of the density of population on malaria in a town where the other conditions

relating to malaria remain constant, there is an exceedingly interesting town in the Punjab not far from Kalka, namely, Maniajra. That town has been studied for many years and we had a very accurate spleen rate of that town taken as long ago as 1896. But since 1896 the population of the town has been halved, I think, by plague. Yet I was unable to find that the halving of the population by plague had produced any really appreciable effect on the spleen rate."

CAPTAIN STILES WEBB :—I should like to say a few words in support of what Captain Gill has just said.

Last year I was carrying out a malaria survey in Palwal, Southern Punjab, and I found exactly the same state of affairs as Captain Gill describes. The mosquito population was greatest at the periphery of the town and so was the human population ; conversely, in the centre of the town, I caught very few mosquitoes and here the population was correspondingly sparse.

Again the peripheral infection of the town, as judged by the spleen and parasite rates, was far greater than the central infection, which was exceedingly small.

In 1908, a year when malaria was epidemic in the Punjab, Major Christophers visited Palwal and found a spleen rate of about 80, and a parasite rate of about 68 or 70. I visited Palwal four times this year and took the spleen and parasite rates. The spleen rate varied between 13 and 18 and the parasite rate from 2 to 4 per cent.

It is rather an interesting point that in such a short space of time the spleen and parasite rates should have fallen to such a great extent.

A practical point in this connection is this, that had a survey been undertaken and the suggested prophylactic measures been carried out, one would naturally have attributed the result to these measures. Here, nothing has been done and yet we have the result stated.

Palwal has been visited during the last 3 or 4 years by a very bad outbreak of plague, and there is yet one other factor there—and that is that there has been some spirillar fever.

In August, in examining some 112 blood films I found 2 infected with Spiroschaudinnia.

The masking of the picture with spirillar fever is worthy of mention I think, and must be considered when we examine the vital statistics and take out the deaths due to " fever."

MAJOR PERRY :—With regard to the question raised by Captain Stiles Webb as to the fever during the epidemic of 1908. The Punjab Government asked both Major Christophers and myself to determine what the fever actually was. It was not taken for granted that the tremendous mortality was due to malaria. Nevertheless, notwithstanding the care with which we examined every blood film which we could get, we never found any evidence to show that there was any other factor relating to that excessive mortality but malaria following on the almost famine conditions that had preceded it. The fact to which Captain Stiles Webb calls attention that the spleen rate and the parasite rate of the town of Palwal have fallen to such a marked extent is paralleled in other places in the Punjab, which after the 1908 epidemic had an enormously high spleen rate and an enormously high parasite rate. I took exceedingly careful measurements at the time of some villages on the Chenab river close to Gujrat and the measurements of the spleen rate and of the parasite rate of those villages have been kept up since then. The spleen rate and the parasite rate have both of them fallen continuously, and they are continuing to fall. I think the spleen rate was something like 75 per cent., while the parasite rate was 60 per cent.; these had by 1912, when I last visited it, fallen to a spleen rate of 16 per cent. and a parasite rate of about 6 per cent., and this year, Captain Gill tells me that it has fallen still further to something like 10 per cent. Of course, these enormous variations in the spleen rate are nothing short of phenomenal, and we have to consider their effect on the question of

epidemic malaria in the Punjab. I must say that I myself am very surprised by this state of things. When I reported to the Punjab Government on the condition of the Gujrat villages after the epidemic of 1908, I said that I was unable to say at the time whether the parasite rate in those villages was more or less a normal condition of the villages or an abnormal condition. Of course we now know that it was a purely abnormal condition. But we feel convinced, however, that such conditions will arise again in the future.

SIR PARDEY LUKIS :—Gentlemen, no one has touched yet on the particular point on which the Scientific Board is extremely anxious to have your views. To us falls the duty of allotting the money which is placed at our disposal for experiments on malaria work. If the delegates don't give us the benefit of their experience, we shall have nothing to go on. I am particularly anxious to have this question thoroughly discussed.

DR. BENTLEY :—In referring to this question of jungle-clearing, I would call attention to Major Marjoribanks' paper. In that paper the author points out there is a probable relation between the occurrence of malaria and trees and grass jungle. Now we find that when we come to the other parts of India conditions vary very greatly. In the Punjab there is comparatively little jungle near ordinary villages, except in isolated places. I believe in the Central Provinces and in parts of the Deccan there are villages of more or less aboriginal tribes, and primitive people, who do not bother to cultivate right up to the doors as the Behari does, and who allow a certain amount of jungle and scrub near their houses or even build their villages near or actually within forest jungle. The latter condition is, I believe, existent in the Jeypore Agency tracts. Now in Bengal conditions are different. It is true that Bengal villages are almost invariably surrounded with dense vegetation. But this vegetation round the villages is not jungle in the true sense, for it is mostly useful in nature. Everyone writing upon Bengal has referred to this condition as peculiar to the country and they have often suggested that it was very harmful. But until recently no one has really investigated this point.

Now I tried to explain to you on Monday that Bengal is deltaic and that everything there is topsy-turvy as compared with the rest of India. The rivers there are distributing canals ; their banks are higher than the surrounding country and they flood over the whole country. Well that is quite different to other parts of India. Now it is the same in regard to this growth round the houses. A villager in Bengal, when he settles down, places his house on a plot of about a third of an acre and he plants fruit trees round the outside edges of this plot. The *bari* which consists of at least four huts occupies the centre of the plot, and the intervening space between the houses and the line of bamboos and fruit trees is occupied by a garden for pot herbs and small vegetables.

As the trees grow larger and larger, the garden growth round the house becomes more and more luxuriant. But the Bengali does not plant his garden in ordered rows as the Behari does. He puts in half a dozen plants here, half a dozen there, and so on. The result is that you have a lot of fruit trees, pot herbs and creeping plants all mixed up together, and when the bigger trees have grown up you will have a dense mass of shade and a ragged mass of undergrowth, 90 per cent. of which is often useful. This is the condition immediately round occupied houses. It is the poorer people who depend very largely for two or three months of the year on the crops of this kind. To casual visitors, whether they be dwellers in the cities who are unfamiliar with the districts like Dr. Kailash Chandra Bose, who, as he himself has said, is not familiar with village life, whether they be Indians or Europeans, this luxuriant growth presents a picture resembling that of wild vegetation in unpopulated tracts. The result is that they run away

and loudly say " this is jungle." But they do not quite know what they mean by the term.

There is no doubt that in certain parts of India, especially the dry areas and in hill climates, the presence of jungle appears to be closely associated with the existence of malaria. But, as I told you on Monday, in Eastern Bengal where we have exactly the same conditions as regards vegetation round the houses, there is practically no malaria, but where malaria has increased in Western Bengal you have, it is true, had an increase of vegetation. I am sorry I did not bring with me some extremely interesting figures which Major Fry prepared, but I will just try to explain what happens in a Bengal village in which real jungle is growing up, and also show how difficult it is for us to apply with hope of success measures which may undoubtedly be extremely useful for other areas. On this sheet which I have just passed round, is indicated part of a village in which houses are shown each surrounded by quite a large plot. Well, so long as the population of your village is not decreasing, all these places are occupied and most of the vegetation is of a useful nature, except that on waste lands round tanks and under the bigger trees which, as you will see, are all away from the neighbourhood of the houses. You have got your dense growth of useful vegetation immediately round the houses. And if you eradicate only the real jungle you only clear at a distance from the dwellings, leaving this screen of vegetation untouched.

When a village is losing population a great change takes place. Owing to the heavy rainfall, and the fertile nature of the soil the vacant house sites are soon overgrown with rank weeds. These weeds being useless are not touched by anyone and allowed to run wild ; a few useful herbs growing there are collected and the remainder left. The result is that as the place becomes more and more depopulated a real jungle grows up. But it must be pointed out that this real jungle which may grow up on vacant house sites is at a distance from inhabited dwellings, which still possess their own screen of useful undergrowth. Under these circumstances it becomes very difficult for us to carry out an experiment that might be easy enough in other places. Some years ago a large number of jungle-clearing operations were carried out in Bengal with a view to mitigating the fever there, but the Commissioner of the Presidency Division records in 1874 the fact that they had absolutely given up the belief that jungle-clearing in Bengal would prove beneficial. In the very villages where the clearing had been most thorough and where practically everything had been cleared away, malaria had broken out with the greatest virulence. There are other ways in which we think it may be possible, now that we have studied malaria more carefully in Bengal, to deal with the problem of malaria. One of them is, I think, on the lines of the suggestion thrown out by Sir Edward Buck. I think in Bengal there is a great chance of being able to utilize river silt from the high-level rivers. This silt would make the waste land fertile, and it would then soon be cultivated by the people who would thus automatically clear jungle. Scrub jungle grows only on practically useless land.

There is also another method with which we are anxious to experiment in Bengal. I am surveying an area in Bengal in which I am anxious to experiment with Malcolm Watson's subsoil drain system as tried by him in the Federated Malay States. I am at present having an area surveyed which appears to lend itself to underground drainage. The proprietors of mines in the district are willing to give every assistance and the only thing which they fear is the cost. We wish to experiment in order to determine not whether we can control malaria in this way because we believe it can be done, but what such work will cost, in order that we may be able to say to the managing agents of tea gardens, etc., here is a measure that you can utilise ; it will cost you this amount, and you can satisfy yourselves whether it will pay you or not.

COLONEL ROGERS speaking as a member of the Bengal Malaria Committee, drew attention to the fact that two such eminent officers as Major Fly and Dr. Bentley, who had been travelling about round Bengal and had reported to his committee, were in entire agreement with regard to the unsuitability of Bengal for jungle-clearing experiments. The strong point Dr. Bentley had brought out was that 90 per cent. of the so-called jungle in Bengal villages was useful material which could not be regarded as rank jungle. Another important point was that in these tracts of Lower Bengal there was really no such thing as a concentrated village, huts being scattered at great distances from one another. Dr. Bentley had spent weeks hunting for a village where this experiment could be successfully carried out: he had not been able to find a single such village and the Malaria Committee was therefore compelled to report that it was a waste of money to spend the Government grant in jungle-clearing in Bengal.

SIR PARDEY LUKIS said he wished to point out an error in Colonel Rogers' statement. The particular grant referred to was asked for by the Bengal Malaria Committee last year who said they could use it for jungle-cutting. After Rs. 50,000 had been placed at their disposal they said they could not use it.

MAJOR PERRY pointed out that viewing the country as a whole the spleen rate over large tracts of the country varied with the density of the population, being lowest where the population is dense and highest where the population is sparse. The only explanation he could give of this was that the spleen rate had been lowered by the clearing of the forest by the larger population.

SIR PARDEY LUKIS (addressing Dr. Bentley) said :—I presume we may take it for granted that the Bengal Malaria Committee does not want to spend this Rs. 50,000 on jungle-cutting and that you make two suggestions ; one is as regards the proposal put forward by Sir Edward Buck, and the other is the experimental adoption of Malcolm Watson's subsoil drainage. I had a conversation with His Excellency the Governor of Bengal in Calcutta and I understood he had some other scheme which you were going to put up.

DR. BENTLEY mentioned that there was a scheme for drainage in a certain town which he had urged upon the Local Government as an anti-malarial measure of the first importance. In a report upon the anti-malarial operations carried on in Dinajpur from 1909 to 1912 he had pointed out that surface drainage of the municipality was essential to success. This report was at present being considered by Government and the Sanitary Engineer was preparing a scheme of drainage. He expected this was the case referred to by His Excellency the Governor.

RAI BAHADUR U. N. BRAHMACHARI mentioned that when the matter had come up before the Bengal Malaria Committee he had not been convinced of the observations that 90 per cent. of the growth near human habitations consisted of useful plants, as the methods adopted to form such determination were open to criticism. The zemindars of West Bengal, with whom he had spoken, had all expressed their willingness to co-operate with Government in measures of jungle-cutting, if money would be forthcoming. So far as he remembered, the objection taken to jungle-clearing on that occasion was that it was not a scientific measure: of this also he was not convinced. It had been pointed out by Dr. Bentley and others that there were various other factors which were contributing to the increase of malaria in Bengal, and any results that might be obtained from the experiment of jungle-cutting could not be conclusive. He and another member of the Malaria Committee had suggested that the experiment might be tried because it was one favoured by the Government of India and nothing was known against jungle-cutting as an anti-malarial measure. So far as he knew, jungle-cutting had proved effective in mitigating malaria in the Panama Canal district. Jungles shelter anophelines during the hot season and during

rains may, by preventing evaporation, give rise to countless pools of water where anophelines may breed, and in that way become fertile sources of malaria. Malcolm Watson's experiments in the Malay States and some of the papers read to-day went to prove that jungle-clearing was efficacious. He still hoped that the experiment of jungle-cutting would be tried in some suitable place in Bengal.

DR. BENTLEY wished to correct a misapprehension on the part of Dr. Brahmachari. What he had said in the provincial malaria committee was not that jungle-cutting was an unscientific measure, but that in Bengal the conditions were so difficult that it became unscientific.

DR. FRANCIS :—I represent Assam, but I live in Chittagong which is in Eastern Bengal. If the Government of India wishes to spend money on jungle-cutting I will guarantee that the whole of the Rs. 50,000 which the Government of India has offered to Bengal can be profitably spent in the small area from Chittagong to the Assam border. Chittagong has a house on every hill ; the bazaar is down below between the hills. Every house is surrounded by jungle 90 per cent. of which is not innocuous. The people, as you may be aware, suffer very badly from malaria. Chittagong, in the old days, was looked upon as one of the sanatoriums of Bengal. It is now one of the hot beds of malarial fever. I am sure that if Government will spend a little of that Rs. 50,000 in Eastern Bengal, we shall be very grateful. The late Government of Eastern Bengal and Assam (whose death I regret) used to give Rs. 6,000 a year to the Chittagong Municipality when I was chairman, to be spent on jungle-cutting. We spent that money and could have spent Rs. 20,000 more.

MAJOR KENRICK pointed out that the experiments in jungle-cutting had been a great success in the Central Provinces.

SIR PARDEY LUKIS enquired whether, if Bengal did not require the Rs. 50,000 granted to them for jungle-clearing, there was any part of Madras where it could be utilised.

MAJOR JUSTICE replied that the money could be used in Madras. On the northern side of the backwater north of Ennore there is an extensive coastline where investigations were being made and they would like to try jungle-clearing. Rs. 12,000 had been sanctioned for this purpose in Jeypore hill tracts, but they would welcome further assistance.

MAJOR CLEMESHA pointed out that the malaria admissions in the dispensaries in the Chittagong Division represented about 6 per cent. of the total, so that the Division as a whole could not be looked upon as malarious. In regard to noxious vegetation it was difficult to quote figures, but people who had spent the greatest amount of time amongst the villagers were of opinion that the rank vegetation formed a very small proportion of the vegetation in the immediate neighbourhood of houses.

He had no doubt that every zamindar in Bengal would welcome jungle-clearing operations for the reason that clearance of jungle would largely increase his profits, as he would be able to utilise the land for growing jute, etc. It was, however, open to doubt whether it would be a scientific experiment to cut down undergrowth and to plant jute which, as the Conference was aware, grew to a height of six feet in good soil.

DR. FRANCIS:—Major Clemesha has told you that the incidence of malaria in Chittagong Division is 6 per cent. I only deal with the dispensaries of the railway which runs through it. The figures there are 38·6 per cent.

DR. BENTLEY:—I would just like to remark that Dr. Brahmachari in his criticism of my paper said I wished to jumble people together in huts. As a matter of fact, anybody who reads the paper will see that I did not intend to do anything of the kind. I suggested model villages and practically modified town-planning. That is surely sanitation if

anybody knows anything at all about it. Captain Gill mentioned Amritsar and said that it did not always follow that the centre of a town was more congested than its peripheral portions. There might be congestion during the day, but this was not the case at night.

But Major Christophers on the other hand tells us that the houses in the centre of Amritsar are 3 and 4 storeys high. My own experience is that in areas where houses are 3 and 4 storeys high the population is usually denser than where they are only one storey high.

Major Perry has told us that in some towns that he knows although plague has reduced the population by one-half he has not been able to detect any difference in the spleen rate. He does not tell us definitely; he only thinks the population has been reduced by one-half. Unfortunately he has not given us any real data to go upon. And in view of the great natural variations that occur in the Punjab from year to year I don't think this counts for much.

I think, as a matter of fact, the point that I made in my paper still holds good, a point that offers a partial explanation at least of the observations which show that as a population increases in density malaria is diminished.

The paper "Malaria and rice "cultivation"† by Major W. H. Kenrick, I.M.S., was taken as read.

(*b*) *Cholera.*

MAJOR GREIG, I.M.S., then introduced his paper "Vitality of the Cholera Vibrio outside the human body," of which the following is a summary:—

This paper is one of a series recording the research work of the Cholera Enquiry which is published in the *Indian Journal of Medical Research*, Vol. I, No. 3, Jan. 1914.*

Previous researches of the author on the life of B. typhosus outside the human host under natural Indian conditions are referred to. The methods employed in the present research are described. 'Uncultivated' strains (94) of the cholera vibrio were employed. Tables (Nos. 3 and 4) and chart are given setting forth the duration of life of each strain of cholera vibrio in the rice-water stools after leaving the host. A table (No. 5) is given showing the total number of cholera vibrios in rice-water stools and the death rate amongst the cholera vibrios. The results are discussed in conjunction with the author's previous researches on cholera and the importance of the human factor is shown. The very successful results in the case of enteric fever of the practical application of measures, based on similar researches, are referred to in support of the last statement.

MAJOR GREIG said:—At the last Sanitary Conference I dealt with the problem of the life of the cholera vibrio in the human host: in the present paper I consider the question of the vitality of the organism after it leaves man.

I refer to the previous observations in 1907 on the life of the B. typhosus outside the human host in India when 'uncultivated' strains, that is to say the bacillus as it occurs in the fæces and urine of carriers and patients and which had never been grown on artificial media, were

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* *Papers of the Cholera Enquiry already published.*

1. Greig. Note on the occurrence of cholera vibrio in biliary passages.—*Lancet*, November 23rd, 1912.
2. Greig. Investigation on the occurrence of the cholera vibrio in the biliary passages.—*Indian Journal of Medical Research*, Volume I, No. I, July 1913.
3. Greig. An investigation of cholera convalescents and contacts, India.—*Ibid*, page 65.
4. An investigation of an epidemic of cholera caused by a 'carrier.'—*Ibid*, page 59.
5. Preliminary note on the occurrence of the comma bacillus in the urine of cases of cholera.—*Ibid*, page 90.
6. Greig. On the cultivation of the comma bacillus from the lung in a case of cholera.—*Indian Journal of Medical Research*, Volume I, No. II, September 1913.
7. Greig. On the Precipitation of bacterial protein by concentrated salt solution and its relation to the bacteriological diagnosis of cholera.—*Ibid.*

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used for the purpose of testing the duration of the life of the B. typhosus. Up to this investigation 'uncultivated' strains had not been used. Tables I and II are taken from the Scientific Memoirs of the Government of India on enteric fever in India.

In the present investigation the strain of cholera vibrio after leaving the human host is not cultivated in artificial media but is allowed to remain in the rice-water stool. Old laboratory strains which had been cultivated on artificial media maintain their vitality longer than uncultivated, as Houston has shown. As cases of cholera occur in Calcutta at all seasons of the year, it is possible to employ 'uncultivated' strains of the cholera vibrio for the purpose of testing the duration of the life of the organism. Consequently in this observation the conditions met with in nature are imitated as far as possible. Table III shows the results.

Table IV shows the months of examination and duration of life.

Table V shows the number of cholera vibrios per c.c. of stool and the mortality of the organism in the rice-water stool.

For the effect of the temperature on the vitality of the vibrio in the stool, please see chart.

Houston has shown that the life of B. typhosus in raw Thames water varies with the temperature, being longer at lower and shorter at higher temperature.

The critical months in Calcutta as regards temperature are December, January and February and the present research shows that the vitality of the cholera vibrio in the rice-water stools is highest during these months. It is interesting to note that the critical cholera months in Calcutta follow directly the low temperature months.

These facts are in themselves interesting and important, but they attain a greater importance and interest when considered in conjunction with the problems which I dealt with at the last Conference. Accurate experimental evidence affords no support to the view that the endemic prevalence of cholera depends on the vitality of the cholera vibrio outside man, but on the other hand scientific research has shown that the cholera vibrio finds very favourable conditions for its prolonged life inside the body of man himself, in the bile and biliary passages.

The human carrier unit, the concentrator and factory of disease, by supplying an adequate dose of the poison to the various distributing channels, water, milk, flies, etc., is in a position to initiate epidemics of cholera.

Shortly put, the problem of the prevention of the spread of cholera is the protection of manhood from man and it is an extremely difficult one to solve. The brilliant results obtained by the anti-typhoid campaign amongst the British Troops in India, which was based on our researches on the typhoid 'carrier' in India, hold out hope in this connection.

Colonel Rogers congratulated Major Greig on the very valuable work he had done in regard to the bacteriology of cholera. The most important conclusion Major Greig had arrived at was that dealing with the septicæmic nature of the disease. Under present methods of treatment they had got the mortality down to 25 per cent. including all bad cases. He thought the time had come to test the effects of serums. Anti-cholera serums should be made and thoroughly tested.

Major Buck:—I wish to propose a resolution to the effect that on an outbreak of cholera it is of the greatest importance to deal with the *places of food supply* with quicklime, as well as to disinfect the drinking water with either quicklime or permanganate of potash.

I would lay emphatic stress on the use of quicklime as a disinfectant.

It is efficacious, cheap, simple to use, obtainable in all towns and there is no prejudice against it in India.

Until recent years—in the Punjab at all events—attention was paid almost solely to the water-supply when cholera broke out; but I am

convinced that it is necessary to go much further than merely to put permanganate of potash into the wells.

Cholera germs not only thrive in water but also in all the dirty places in and near habitations—thence they are carried by means of flies and in other ways to food and to pots and pans.

It will have been the experience of everyone who has had to fight this disease that the disinfection of the water-supply alone has not stamped it out.

Now the best method for getting rid of flies quickly, and for destroying the cholera germ, is to smother with quicklime all places where the larvæ of flies and the germs of cholera are likely to be lurking.

Large quantities of quicklime should be conveyed at once to the affected area—ten maunds might be taken as a minimum—there it must be laid in the drains, on the floors and shelves of food shops, especially those of *halwais*, *manwais*, greengrocers and butchers—in all privies and cesspools, on filth heaps and all dirty places. It must also be sprinkled on the lower parts of walls where the larvæ of flies may be.

Especially is it necessary to treat slaughter-houses and their surroundings with this substance.

Other matters to be looked to during the prevalence of cholera are the general scavenging, the protection of ponds and wells from pollution, the control of the dhobies who wash the clothes of those persons in whose houses the disease has occurred, the immediate treatment of patients' stools and the continual disinfection of the houses, food places and privies of patients, while the outbreak lasts. All of these operations can be suitably performed with the aid of quicklime.

In my District during the past six years cholera has been successfully dealt with in the manner I have described. The only difficulties we have to contend with are :—

Firstly, to secure a prompt report on a case occurring ;

Secondly, to obtain immediately a sufficient supply of unslaked lime ;

Thirdly, intelligent persons to carry out the operations of laying the quicklime.

But these can all be overcome. It is imperative to test the lime before use for quicklime soon becomes slaked if it is not kept perfectly dry.

As I have already hinted, one of the great advantages of quicklime is that everyone knows what it is, and it hurts the feelings of no one except those of the cholera germs and flies—Gentlemen, I put in a plea for quicklime.

Dr. Kailas Chandra Bose drew attention to the fact that they laboured under a disadvantage owing to the absence of the compulsory notification of infectious diseases.

Educated people well understood the proper use of disinfectants and did not object to them ; but other people appreciated their value but little. Pilgrims and cholera are linked together. Cholera had a seasonal prevalence and came on during the months of July, August, and November, December and January which was the period when pilgrims resorted to the sacred shrines of Jaggernaut and to the Magh Mela. These pilgrims brought with them the germs of the disease of which they became carriers. He advocated a further trial of prophylactic inoculation with an anti-cholera vaccine. Excreta should not be thrown into the streets (as at present) when flies could carry the germs to the houses : and village people, who use pond water, should be advised to boil it before use.

Dr. B. B. Bramachari then read the following summary of his "Note on Cholera as an Endemic in Cossipur-Chitpur, Bengal."*

Cholera as an endemic in Bengal accounts for not less than 8 per cent. of the total mortality, in towns its share being even higher, over 10

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per cent. In my paper, I have sought to show from (1) nature of the population ; (2) varying meteorological conditions and concurrent condition of fly infestation, and water used by the people for domestic purposes other than drinking, and (3) condition of the town as regards water supply and conservancy, that the endemicity in Cossipur-Chitpur is due to the disease starting in most cases in connection with carriers, imported and local, and spreading as a rule through water and flies. In the light of the above facts, I have sought to show also the difficulties we have to meet in our attempts to check the disease from want of any system of notification, adequate legal power to control private sources of water, and from the innate insanitariness of the existing system of conservancy. I have shown also the inadequacy of sections of the Bengal Municipal Act dealing with contaminated and unwholesome private tanks and wells.

(c) *Relapsing Fever.*

MAJOR BISSET, not being present, his paper on "Relapsing Fever in the Meerut division "* was taken as read. The following is a summary : —

Of lice caught on sufferers from relapsing fever 26·3 per cent. were found to be infected with spirochætes. The percentage was found to vary from 12 per cent. to 57 per cent. in different villages.

The work of other observers is confirmed as to spirochætes in the louse being in the cœlomic fluid, and not in internal organs, although the author believes they are present in the stomach contents. It is reported that spirochætes were found three times in freshly passed droppings. Attempts to convey the disease to animals by the bites of lice, by inoculations of crushed lice, or by rubbing fresh droppings into excoriated surfaces, failed.

Certain epidemiological data are given pointing to the spread of the disease by lice. The almost complete absence of bugs from village beds is commented on. Ticks were found not to be infected. The mortality is stated to vary greatly in different villages—no death among 22 cases in one village, and 5 among 13 in another, are quoted. The author believes that the mortality among males is considerably higher than among females, but figures are not given in support of this opinion.

The majority of deaths are attributed to exhaustion and to unsuitable food during convalescence. Attention is drawn to a common belief, fostered by hakims, that a case of fever should be starved. When this prejudice is overcome the sick are said usually to recover.

Preventive measures must be directed towards the extermination of lice by personal cleanliness. Owing to the fact that the better classes are seriously inconvenienced by the scarcity of labour when the disease attacks a village, it is hoped that their influence may the more readily be enlisted in the promotion of such measures.

DR. BENTLEY :—I would just like to remark that Captain Jukes told me of some cases of relapsing fever studied by him in the Darjeeling district. They are extremely fatal ; in one small epidemic 7 out of 8 patients died in a few days. The symptoms were marked jaundice, vomiting, very high fever and in some cases almost coma. So far as he had discovered, they seemed to be sporadic outbreaks occurring among the small villages in the hills. I have seen some of the specimens and it seems possible that it is a new species and differs from some of the described species.

CAPTAIN MACKIE :—It has been a matter of great interest to me to read Major Bisset's convincing paper on the experiments which he carried out in the United Provinces, chiefly because this represents the first experiment on a considerable scale to prove or disprove the hypothesis which I advanced 5½ years ago as to the part played by the body louse in the transmission of relapsing fever. It has also been a matter of great

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interest to me that he has endorsed my findings as to the transmissive power of the body louse, at any rate in its main features. There are only two points I should like to refer to in his paper. One refers to the mechanism of infection, and the other to the question of the identity of the various relapsing fevers in India. As to the mechanism of infection, I may remind you that in my original investigation I came to the conclusion that the seat of multiplication in the body louse was primarily the stomach, and that infection took place from the stomach by regurgitation of alimentary fluid during the act of sucking. This was rendered probable by the fact that by very gently pressing the head of infected lice one could obtain a small amount of fluid which was teeming with active spirochætes. Since then a very important piece of work has been done by Nicole and his associates and they have come to the conclusion that the alimentary canal is not the seat of infection, at any rate in the body louse which causes the Algerian form of relapsing fever. They find that the cœlomic fluid is the part of the louse which is infected. Infection from louse to man takes place by the crushing of body lice in the act of killing them. Apparently, Major Bisset is not quite decided in his own mind which of these two is the correct theory, because contrary to Nicole's experience, he finds that, after the most careful washing of the stomach and the alimentary tract, he is still able to find active spirochætes in the stomach. So this point must be considered at present unproved.

The second point that Dr. Bentley has mentioned is the question of the identity of relapsing fevers in various parts of India. Those gentlemen who have worked in these outbreaks have been good enough to send me, I think in every case, specimens of the spirochætes which they have found, and morphologically I have not been able to satisfy myself that there has been any difference between them and the type of fever which I met with in the Bombay Presidency and which is the one with which I am most familiar. However, the morphology of spirochætes is not very different and it is very difficult—according to some impossible—even to distinguish the spirochæte of African tick fever, which is certainly carried by a tick and not by a louse, from the American, the European and the Indian forms. So that morphology alone is not a very safe guide to the differentiation of spirochætes. As to the clinical differentiation, I was at some pains some years ago to try and ascertain the various points for and against differentiation of the various relapsing fevers from a clinical point of view. I do not think that the evidence which Captain Jukes has brought forward is sufficient in itself to prove the disparity of the two forms of relapsing fever, because one frequently, in the middle of an outbreak which shows a very low mortality, gets a series of cases in a certain house or certain village, where the mortality is very much higher and due to conditions we do not understand. Major McCowan some years ago wrote an account with me of an epidemic which occurred in a military cantonment where there was a very sharp differentiation of cases from a clinical point of view, in one of which the mortality was about 3 or 4 per cent. and in another where it was 20 or 25 per cent., so I do not think the evidence we have yet is sufficient to enable us to say whether the various forms of spirochætes in India are similar or dissimilar. To that end, I would suggest that one man should be deputed to go and study the disease in different areas, so that he might get a continuity of observation and a comparison of the various types of fever.

Sir Pardey Lukis :—I think I was right in what I said, that you examined lice and bugs from those cases of Jukes ?

Captain Mackie :—No, Sir, only the slides that he sent me by post. I have not examined the insects.

Major McCarrison :—A point of prophylaxis to which I would desire to direct attention is the use of sulphur. It is well-known that sulphur taken by the mouth is excreted by the skin and it appears

highly probable that it acts as a deterrent to the bites of ectoparasites. In a recent issue of the *British Medical Journal* I read the statement that a lump of bar sulphur placed in the drinking water of dogs had the effect of freeing them from fleas. It was also recorded in the same Journal—so far as my memory serves me—that a physician, whose duties took him amongst the lowest stratum of society in one of our large towns, was accustomed to take sulphur in small doses as a prophylactic against the bites of fleas. He recorded that the measure was highly successful. I am informed that sulphur is commonly used in this way by the natives of certain parts of India as a protection against plague and cholera. A block of sulphur is placed in the water used for drinking purposes and is supposed to afford protection against these maladies, though how it could do so in view of the fact that sulphur is not soluble in water it is difficult to see. The practice is however an interesting one.

Captain Brown has carried out an interesting experiment in this connection. He administered 5 grams of sulphur once daily to 49 persons who had come into intimate contact with cases of relapsing fever. Of these, 4 or 8·1 per cent. subsequently developed the disease, while of 132 contacts not so treated 24 or 18·1 per cent. developed the disease. The figures are of course too small to admit of any dogmatic assertion as to the utility of sulphur as a prophylactic, but the results of the experiment are very suggestive.

An interesting experience has recently been recorded in the German Journals. Some experimenters were engaged in the inoculation of a monkey with spirochæte holding material. Two of them wore spectacles, two others did not. At the crucial moment of injection the monkey jibbed and the spirochæte containing material was squirted into the faces and eyes of the three experimenters. He who wore glasses on which the fluid was undoubtedly deposited escaped infection, while the other two developed relapsing fever.

Colonel Rogers asked whether by putting sulphur in the drinking water of human beings the rat flea would be prevented from biting them.

Major McCarrison replied that it was the custom in India to put a lump of sulphur in the drinking water with a view, he had been informed by certain Indian gentlemen, of preventing, not only plague, but cholera. He had heard that this had been going on from time immemorial.

(*d*) *Guinea-worm disease.*

Major Glen Liston, I.M.S., introduced the paper by himself and Dr. Turkhud on "Guinea-worm disease in an Indian village,"* and that by Dr. Turkhud on "The distribution of Guinea-worm in India."* The following are summaries of the papers :—

The authors preface their paper with a brief description of the manner in which this disease is acquired. They point out that the guinea-worm has to pass through two phases of development, the one in man and the other in a cyclops. Theoretically, therefore, the extermination of this disease is a very simple problem, it is only necessary to prevent the embryos gaining access to drinking water containing cyclops, or failing this, to remove the infected cyclops by straining the water through a cloth.

Yet the disease is common in many parts of India ; and the question is asked why, if its prevention is so simple, is it so prevalent. The authors give an answer to this question based on their experience of the disease in the little village of Sarsola in the Thana district of the Bombay Presidency. Here they found that every third person in the village had at one time or another suffered from the disease. The source of infection was ascertained to be a dilapidated well owned by the villagers. In this well infected cyclops were discovered. The cyclops were shown to the villagers, and they were told that they acquired the disease by swallowing these creatures. They were also shown how the cyclops could be easily removed from the water by straining it through a piece of cloth.

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They were advised at the same time to put their well in proper repair and to prevent persons bathing in it. The villagers remaining indifferent to these suggestions. An educated and influential resident near the village offered to assist them by obtaining a grant from the Local Board to help them to repair their well. The villagers would not listen to this suggestion, fearing that they might lose their rights over the well, nor would they assist this gentleman in acquiring land on which to sink a new well. The authors were surprised to find that even in the dry season when the water was scarce, the villagers prized this commodity so little, that men and boys were allowed to bathe in the water which at this time was hardly sufficient to fill a small bath-tub, and was, moreover, their only drinking water.

The prevalence of guinea-worm disease in India is due largely to the suspicion, the ignorance, and the indifference of the people, and to their lack of co-operation with one another and with Government. There are no scientific, physical or financial difficulties to be overcome, the problem is entirely a social one. The authors hope that Government will sink a new well in this village. This well should be covered and supplied with pumps. The gentleman already referred to has agreed to supply the latter on the condition that Government obtain a site, sink the new well, and close the old one.

An example of this kind should stimulate the inhabitants of other infected villages in the neighbourhood to take similar action.

In the paper on " The distribution of Guinea-worm disease in India " an attempt is made to ascertain the extent to which guinea-worm disease prevails in India. The author finds that the only statistics available for the purpose are those given in the annual reports of the Sanitary Commissioner with the Government of India in connection with Indian troops and prisoners, but these figures do not give an adequate idea as to its prevalence among the general population. Dracontiasis, though a disease which can very easily be prevented, is yet responsible for much suffering. It occasionally causes permanent deformity and may seriously interfere with agricultural operations. It is desirable, therefore, that accurate information should be available as to its distribution and prevalence. A suggestion is made that all cases treated in hospitals and dispensaries should be recorded in a separate column in the official returns.

Statistics are given showing the prevalence of the disease among Indian troops and prisoners. The figures for any given area for these two groups vary, but explanations are offered for the discrepancies. The author thinks that the figures referring to prisoners probably give a more accurate estimate of the distribution of the disease.

Judging from the figures which concern prisoners, the most severely affected area in India appears to be the western portion of the Madras Presidency, which shows the high annual ratio of 39·69 cases among 1,000 prisoners. The next most severely affected part is the Deccan proper, with a ratio of 28·10 per mille. Then come the Northern Circars, Madras and Carnatic, Guzerat, the western coast, and the Indus valley, with ratios varying from 12 to 10 per mille. All hill stations, Burma and the Andamans, appear to be free from the disease.

Major Marjoribanks :—Although Major Liston has spoken of advice he has given to villagers by recommending them to repair their wells and to strain their water through a cloth, he has not spoken of any radical method of dealing with the well itself. It would be interesting to have from delegates of different Provinces an account of the different methods used to free wells from guinea-worm in the various parts of India. In the Deccan the method I have found most often employed is to pump the well as low as possible and then pour in a large quantity of quicklime. This is possible because of the fact that quicklime is a very active chemical substance. Unfortunately, however, quicklime loses its chemical activity at once in a large bulk of water, and

it is not likely that this means is of any practical use. The substance on which I should be most inclined to rely would be permanganate of potassium, with the use of which in anti-cholera measures the villager is by now quite familiar. I think we may assume that, especially when the well has been pumped out by the villagers a good dosing of permanganate of potassium would be as certain a method of destroying the parasite as could be found, and I should be inclined to recommend its wide adoption.

SURGEON-GENERAL BANNERMAN mentioned for Major Marjoribanks' information that that method was used in a well near Bombay. At the Parel laboratory they had obtained cyclops from Bandra and had found that a little permanganate of potash killed the cyclops off very quickly.

MAJOR GLEN LISTON did not think that the treatment with permanganate of potash was a very radical one as the well would, in a short time, become infected with cyclops again. The great thing was to prevent men entering the well or allowing water from their feet to enter the well. The well should be covered over and a pump applied: that was the radical method he would recommend and which he suggested should be applied.

MAJOR MARJORIBANKS said that from his own experience in the Deccan he thought the villagers could not be got to use a pump, as there was a very very strong prejudice against the use of water pumped up from wells. He thought the great point, at any rate in the Deccan, was the abolition of the old step well. He presumed that step wells were a feature of other parts of India as well as the Deccan. It had certainly been noticed that step wells were more likely to be infected than others, and he would not be inclined to recommend the use of permanganate of potash without at the same time recommending District and Local Boards to take thorough measures to block up the steps in as many wells as possible.

MAJOR GLEN LISTON explained that the particular well referred to in his paper was not a step well, but one down which it was easy to climb.

SECTION B.

First Session

Inspection of Lucknow.

The delegates assembled at 9 A.M., at the corner of Abbott, Station and Hewitt roads and inspected the following :–

(*a*) the Hewett Road improvements ;
(*b*) the new grain market ;
(*c*) a demonstration of disinfection by hydrocyanic acid gas ;
(*d*) the cloth market ;
(*e*) water flush latrine with liquefying tank ;
(*f*) Aminabad school ;
(*g*) cement paving of smaller roads and lanes ;
(*h*) a section of the main drainage system.

[The delegates inspecting Lucknow were divided in to four parties under the guidance of Mr. Horde, Mr. Gwynne, Mr. Hewlett and Dr. Sousa who kindly acted as guides.]

The Conference re-assembled at 10 A.M., at the Medical College.

SECTION B.

Second Session.

The Hon'ble Major J. C. Robertson, C.I.E., I.M.S., Presiding.

Lantern Exhibition of type designs.

The following papers were taken as read in connection with the Lantern Exhibition of type designs in use or proposed for use in the various provinces.

(I) DESCRIPTION OF TYPE DESIGNS RELATING TO WATER CARRIAGE PUBLIC LATRINES AND PAIL DEPOTS, COLOMBO.

BY

Mr. C. L. Cox.

The paper describes the type designs, and is accompanied by plans illustrating the same, with reference to the system of water carriage, public latrines and night-soil tipping depôts as used in Colombo.

In his absence from the Conference, Mr. C. L. Cox desired the following to be included in the proceedings: "As I shall be denied the privilege of taking part in the discussions at the forthcoming Conference, I should be glad if it may be noted that I shall be pleased to reply in writing to any questions raised in connection with my short description of the Colombo Public Latrines and pail depôt, or to give any delegates further information if required."

(II) NOTE ON NIGHT-SOIL DEPOTS.*

BY

Mr. J. W. Madeley.

A night-soil depôt specially designed for Madras is described. It has been in working for two years and has proved so successful that the Health Officer has asked for the system to be extended to the whole city. This would not only abolish the existing objectionable and out-of-date conservancy methods, but would prove more economical, and result in a saving of 25 per cent. on annual upkeep.

(III) NOTE ON FLUSH LATRINES USED IN THE CITY OF MADRAS *

BY

Mr. J. W. Madeley.

A description is given of two standard types of latrines as adopted for Madras city.

* Volume

(IV) WELL HEADS AND THEIR PROTECTION AGAINST POLLUTION.

BY

MR. H. A. GUBBAY.

The author points out the necessity of care in the selection of sites for sinking village wells. Protection of the well heads is equally necessary as the people frequently wash their bodies and their clothes near the well head, and contaminated water drains back into the well and pollutes it.

Wells should be so constructed as to prevent sub-soil contamination and the re-entrance of drippings and washings of water already used.

The paper details the arrangements devised to prevent such pollution, and is illustrated by three plans of well heads.

Various plans of types of markets were thrown on the screen. Mr. Salkield showed photographs of the new pattern markets built at Delhi.

Mr. West showed plans of a revolving gauze door with four leaves, the door being always closed.

Mr. Disney showed plans of the fish and meat markets.

A slaughter-house suitable for cantonments was shown by Mr. West.

The various points in the construction of a slaughter-house based on the Chatham Dockyard, the question of cooling rooms and floors, were explained by Mr. Robertson.

Plans of hide-curing godowns and designs for model houses in the United Provinces were displayed by Mr. West.

Mr. Robertson showed coolie huts of ferro-concrete erected by the Darjeeling Municipality.

The design of a suggested model mosquito-proof house was explained by Dr. Newell.

Mr. Robertson displayed a plan of Darjeeling showing the general arrangement of sewage pipes and jhoras.

FOURTH DAY, THURSDAY, 22ND JANUARY.

*Visit to Hardwar.**

On Wednesday night, 21st of January, the medical and engineering delegates of the Conference left Lucknow by special train for Hardwar. On arrival next morning the train was taken to Bhimgoda where the delegates detrained, visited the sacred tank, and inspected the sanitary arrangements for pilgrims. The engineering delegates then proceeded to Dudhia Bund, the site of the new weir for the head-works of the Ganges canal. Mr. Hall, Executive Engineer in charge, explained the plans and proposals which involve an expenditure of 40 lakhs of rupees. The whole party visited Har-ke-pairi, the Esplanade and Bazar, and inspected several lodging houses and dharamshalas. The permanent sanitary arrangements and special arrangements necessitated during melas were inspected by the delegates, and explained by Major S. A. Harris, I.M.S., Sanitary Commissioner, United Provinces. Later Mr. C. H. West, Sanitary Engineer, United Provinces, demonstrated the plans of the proposed water-supply and drainage scheme for the Hardwar Union. Many of the delegates then visited Bahadurabad, about seven miles down the canal, where is situated the new hydro-electric machinery worked by the falls at Bahadurabad and Salempur, and recently erected by Messrs. Siemens Brothers for the Irrigation Department. Other delegates meanwhile visited the temples and bathing ghats at Kankal. In the afternoon the arrangements made at the station for the control and comfort of large crowds of pilgrims were explained by Major S. A. Harriss, I.M.S. The special train left Hardwar at 6 P.M., arriving Lucknow on Friday morning at 7-30.

* "Notes on Hardwar."—Vol. IV.

FIFTH DAY, FRIDAY, 23RD JANUARY.

SECTION A.

FIRST SESSION.

THE HON'BLE SIR HARCOURT BUTLER, K.C.S.I., C.I.E., I.C.S., PRESIDING.

Town-planning and improvement.

THE HON'BLE MR. J. P. ORR introduced his paper on "How to check the growth of insanitary conditions in Bombay City,"* of which the following is a summary:—

For some years past there has been much talk in Bombay as to the necessity of securing that the future development of the city shall proceed on sound lines, and much has been done and more is being planned to this end; but in the pursuit of this object the citizens are apt to confine their attention to areas yet to be built on, and to lose sight of the fact that in areas already built over under the old bad methods of haphazard development, insanitary conditions are rapidly, though unobtrusively, going from bad to worse.

2. The author's main object is to impress on the citizens of Bombay the necessity of checking the growth of these insanitary conditions and to show what a long way the adoption of the Bombay City Improvement Trust's 63½° rule will go towards securing the attainment of this object.

3. The 63½° rule is based (*vide* paragraph 7 of the paper) on the principles :—

(1) that the higher and more extensive a building is, the greater must the open space around it be, and

(2) that such exterior open space is just as much a *sine qua non* for a house as the plinth, walls and roof.

4. Until recently, the owner of a house site in Bombay city was at liberty to build over almost every inch of it, but the 63½° rule requires that a person intending to build a house on a certain plinth must own not only the space vertically above the plinth, but also additional air spaces above certain planes drawn downwards from the top of the rear walls and upwards from the floors of all rooms used for human habitation at an angle of 63½° to the horizon. These planes are called air planes and light planes, respectively, and can be best understood from a study of the models before the Conference.

5. The 63½° rule requires that every person who shall erect a building on a Trust plot shall provide it with adequate means of access for external air on its rear side, and shall provide every room intended for human habitation in it with adequate means of access for external light; and it lays down the following standards :—

(*i*) A building is deemed adequately provided on its rear side with means of access for external air, if the whole space vertically above all its rear air planes is a permanently open air space.

(*ii*) A room is deemed adequately provided with access for external light for the purpose of human habitation, if the whole space vertically above at least one of its light planes is a permanently open air space.

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6. The paper shows what are the main evils resulting from certain defects in the Bombay City Municipal Act and the bye-laws thereunder; and suggests certain remedies: these are set out in brief in the recapitulation in paragraph 54, which is as follows :—

I have pointed out that the insanitary condition of the congested areas in Bombay is laregly due to defects in lighting and ventilation of houses; that the amendments in the Bombay City Municipal Act and bye-laws which Mr. Harvey suggested in 1901, with a veiw to removing these defects, though considered when the Act was amended in 1905, and when the new bye-laws were passed in 1910, have not yet been carried out, and that consequently evils resulting from these defects have gone and are still going from bad to worse in the areas in question in the 12 years that have elapsed since Mr. Harvey first brought the matter to the notice of the municipality. Following in the main Mr. Harvey's recommendations, I have recommended certain remedies for the several defects, the chief of which are as follows :—

Defects in the Act and Bye-laws	Evils resulting therefrom.	Remedies suggested.
Para. 9.—Want of a legal limit to the height of a building that does not abut on any street.	*Para. 9.*—High buildings erected in higgledy-piggledy disorder shutting out light and air from neighbouring buildings.	*Para. 10.*—Enact that such buildings shall not be extended until the limits of the streets on which they are ultimately to abut have been determined. Enforce section 348 (*b*) to prevent the erection of any more such buildings.
Para. 11—Want of a legal limit to the height of buildings in the rear.	*Para. 11.*—Buildings gradually rising towards the rear in set-backs erected so as to shut out light and air from their neighbours.	*Para. 11.*—The Municipality should at once adopt the Trust's rear air plane rule and a corresponding front air plane rule in their building bye-laws.
Para. 13—Want of a provision requiring every house to be provided with rear open spaces.	*Para. 13.*—Foul narrow gullies between the backs of buildings.	*Para. 17.*—For congested areas the Municipality should at once adopt the Trust's rear air plane rule and (*para. 20*) for other areas the Calcutta rear air plane rule.
Para. 22—Inadequate provision in Act and bye-laws for side open spaces for lighting and ventilation of side rooms.	*Para. 22.*—Long foul narrow gullies between high houses the only means for lighting and ventilating side rooms abutting on them.	*Para 28.*—The Municipality should adopt the Trust's 63½° light plane rule.
Para. 32—Inadequate provision in Act and bye-laws for securing lighting and ventilation of interior rooms from chauks.	*Para. 29.*—Far too small chauks constructed only to serve as rubbish shoots.	*Para. 36*—The Municipality should adopt the Trust's 63½° light plane rule.
Para. 37.—Want of a prescription as to the relation between the window area and the floor area.	*Para. 37*—Deep narrow rooms inadequately lighted are partitioned off into separate tenements of which only the one nearest the exterior wall gets any light or air.	*Para. 40*—The Municipality should adopt the Trust rule (*para 38*) requiring every room to be lighted by windows opening on to an adequate exterior open air space with openings equal to at least ⅐th of the floor area.

Defects in the Act and Bye-laws.	Evils resulting therefrom.	Remedies suggested.
Para. 43.—Inadequate control over alterations of old buildings.	*Paras. 44 & 45* —Old buildings reconstructed piecemeal are not subject to new bye-laws with the result that the original defects remain unaltered : while new storeys added to old buildings, though themselves subject to new bye-laws, aggravate the evils resulting from inadequate lighting and ventilation of the old buildings below them.	*Para. 47.*—The bye-laws should provide that no addition to an old building shall be allowed unless the whole building is altered so as to satisfy the requirements of the new bye-laws and (*para. 49*) that when substantial alterations are made in any room the whole room shall be so altered as to bring it into conformity with all the latest building regulations.

7. The detailed exposition of the 63½° rule and the Trust's method of applying it, is given in Appendix B, along with diagrams illustrating the several cases dealt with.

8. In Appendix C is set out the important report in which the Municipal Commissioner, the late Mr. W. L. Harvey, drew the attention of the Bombay Municipal Corporation in 1901 to the same evils, which, much intensified in the intervening 12 years, the present paper deals with, and suggested remedies on much the same lines as the 63½° rule follow : and the report is preceded by a précis showing what action the Corporation have taken towards dealing with these evils since 1897.

9. Appendix D merely reproduces for facility of reference portions of Acts and bye-laws referred to in the main paper.

Mr. Orr said :—In my lecture entitled "Light and Air in dwellings in Bombay," which I had the honour to bring before the All-India Sanitary Conference at Madras, I gave some account of the Bombay slums and, *inter alia*, I pointed out that the insanitary condition of the older and more congested building areas must continue to go from bad to worse, so long as the control of building operations on old buildings remained as ineffective as it then was and still is under the Municipal bye-laws. I suggested that the 63½° standard of light and ventilation which is enforced on the Bombay City Improvement estates should be extended to the whole of Bombay, to new buildings at once, and to old buildings gradually. Both the Bombay Government and the Municipality appointed committees to consider the subject of my lecture and both committees showed an inclination to favour the 63½° standard ; but as it was evident that some of the members did not clearly understand the exact nature of the 63½° rule and how it was applied in practice, I wrote an explanation which is embodied in Appendix B to the note which I am now introducing to this Conference, and at the same time took the opportunity to impress once more upon the citizens of Bombay through this covering note, the pressing necessity of checking the insanitary conditions which, for want of adequate bye-laws, are rapidly, though unobtrusively, going from bad to worse. I bring this note before the All-India Sanitary Conference because I believe there are other cities besides Bombay which are suffering from insanitary development in the past and from lack of effective building bye-laws, and I want the Conference to consider whether the adoption of the 63½° rule or at any rate of the principles underlying it, is, or is not, desirable as one means towards the sanitary improvement of those cities. I do not suppose any city has come to quite so bad a pass as the congested area of 994 acres in the heart of Bombay city, particulars of which can be gathered from the map of which I have supplied a few copies here. I should like similar maps prepared for many other cities. You will see from that map that the density of population varies from 200 to 1,179 souls per acre in

different census circles, while the average for the whole area of 994 acres is no less than 391. Now in London the density of population is almost the same as in Bombay : the average for Bombay city is 67 and the average for congested parts of London is 64. Sanitarians there are horrified at this high rate and want to reduce it to 42, while they want to reduce the density of population in the suburbs of London to 25, which I am glad to see is the density aimed at and so far achieved in the Bangalore extension, a paper on which we have before us. A density of 64 in London horrifies the sanitarians there, but we have an average density of 391 in the congested areas in Bombay. I saw a Lancashire paper the other day in which there was a long article on the density of population in Manchester. There was one district there, the Hulme district, which is far and away the most congested and that has a density of 124. We are dealing with much greater density here, not over a small area but over an area of 994 acres. You may be inclined to ask at first why you should concern yourselves with Bombay when the cities you represent are comparatively thinly populated. I would ask you to consider, not the average for the whole of your city, but the figures for particular circles. Yesterday I was in Cawnpore and I made enquiries there about the density of population. I found that the average density of the Civil lines was only 25 per acre and that of the city proper 115 ; but there were two areas, the Butcherkhanas with a density of 532, and the coolie bazar with a density of 563. I would also remind you of the risk of particular areas becoming in a few years far worse congested than they are now, if you do not apply at an early date those checks on sanitary development, the absence of which has brought such ruinous expense upon the citizens of Bombay in their too long deferred efforts to remedy the evils which have been brought upon them by the apathy or want of foresight of their fathers. I have here models which show what a certain group of houses was according to the maps of 1872, and I understand for many years after that, probably until 1886 or thereabouts, and what they are now. Those who can see the model will notice that there were three one-storeyed buildings and one two-storeyed building in front, with ample air-space behind them, and a few detached buildings in the rear. The space occupied by the compounds of those buildings is now covered with solid buildings which are three of them three-storeys and one four-storeys high. Mr. Orr then proceeded to explain another model. Houses of one, two and three-storeys which were constructed in the eighties had since had further storeys added to them. These houses had only a very narrow gully, two or three feet wide running between them and were very insanitary. He said it was in the direction of preventing such extension of buildings upwards and outwards that he wanted to see bye-laws made everywhere, and it was necessary that such bye-laws should apply to old as well as to new buildings. The general rule in England is that no building shall be allowed to be extended upwards or outwards unless it is brought entirely into conformance with the most up-to-date bye-laws. In Bombay it was considered confiscation to prevent a man from building as high as he liked on a plinth on which he had once been permitted to build one-storey. He had got a good deal of instruction from his visit to Cawnpore in this connection. He noticed that there they had extreme density of population in some parts, but had to deal only with kutcha houses one or two-storeys high. This might have been the case in Bombay 20 years ago, but pressure of population on the soil had increased the sizes of the houses with the result that when the Improvement Trust wished to acquire any particular slum, they had to pay compensation based on rentals of rooms which were probably four times as many as they were 20 years ago and rents which were for each room at least double of what they were 20 years ago. The extension of buildings upwards and outwards thus, not only aggravates insanitary conditions, but also makes it more expensive to

remove or improve them. He continued :—My note commences with a statement of the 63½° rule and an explanation of the principles which underly it. As I have explained, the 63½° rule really covers a series of rules. The two rules that I might read are :—

A building is deemed adequately provided on its rear side with means of access or external air, if the whole space vertically above all its rear air planes is a permanently open air space.

A room is deemed adequately provided with access for external light for the purpose of human habitation, if the whole space vertically above at least one of its light planes is a permanently open air space.

These rules are directed towards securing ample exterior open space in rear of all buildings, whether intended for human habitation or not, and ample interior and side open spaces for the lighting and ventilation of rooms used for human habitation that are not lighted and ventilated from the front or rear of a house ; they practically limit the portion of a building site on which the building may be built, so that the plinth can never be co-extensive with the site : and incidentally they also limit the height of the rear part of every building in proportion to the open space around it, on the principles :—

(1) that the higher and the more extensive a building is, the greater must the open space around it be, and

(2) that such exterior open space is just as much a *sine qua non* for a house as the plinth, walls or roof.

In illustration of this second principle which I am extremely keen to see adopted everywhere I have brought some models.

Mr. Orr then explained the models and pointed out that on Bombay City Improvement Trust Estates they did not bother about front air planes, because there was a rule that the house could not be higher than the street was broad. That meant a front air plane of 45 degrees, the height of the houses being equal to the width of the road. At the rear, though they would have liked to insist on a 45° air plane, they did not find this practicable, the value of land in Bombay being very high, but they insisted on the 63½° rule. If a house was 60 feet high the rear open space was 30 feet broad and they never allowed any less rear open space than 10 feet. What they wished to get people to understand was that, if they had a particular site, what they had got to put on it was not merely a house, but a house with exterior air space which should be considered just as much indispensable to the house as the walls and roof and plinth. He showed a model of a continuous building with rooms lighted either from the front or the rear. In the front the 45 rule must be satisfied and in the rear the 63½° rule. If rooms were built in extensions depending on side open spaces for their light and air then, the house being 48 feet high, the side spaces must be 24 feet broad.

Mr. Orr went on to say :—The point I wish to emphasize particularly is that some minimum exterior air space should be prescribed as an indispensable adjunct of every house, and that a house should not be permitted to be built upon a particular site unless there is room in the space vertically above that site, not only for the actual structure of the house, but for the prescribed exterior open space around it. The 63½° rule is of course far from sufficient in itself to insure sanitary development in the future, but if it is everywhere recognised that a house cannot be built or rebuilt on a given area unless there is room in the air space vertically above that area, not only for the structure, but also for the external air space, recognised by the 63½° rule as an indispensable adjunct to that structure, then one of the chief causes of the congestion that so many towns complain of will have been removed.

After rehearsing the rules and explaining the principles on which they are based, my paper goes on to treat of the bearing of the 63½° rule first upon the height of the building, secondly upon the ventilation and lighting of the building, and in ventilation and lighting I treat

of rear open spaces, side open spaces, and interior open spaces; and finally there is a recommendation as regards window area. I wish to say a few words as regards rear open spaces. Even if you do not adopt the whole of the $63\frac{1}{2}^{\circ}$ rule, you can go a very long way to improve matters if you insist upon a rear open space. In Calcutta the $63\frac{1}{2}^{\circ}$ rule has been in force for some years as regards rear open spaces. Unfortunately they do not apply the same principle to side open spaces. I do not know why; but I imagine it is because possibly they do not often have rooms dependent on side open spaces for their light and air; but I hope Calcutta will consider the advisability of adopting the Trust's $63\frac{1}{2}^{\circ}$ rule for side spaces and for chowks as well as for rear open spaces. I want to explain that we have coined this phrase "air plane" in order to checkmate people who said they did not require light for certain rooms in the rear which they said were intended for stores or privies. Now the advantage to my mind of rear open spaces is that you insure between long rows of buildings a sufficient perflation of air in the rear, just as the road provides a sufficient perflation of air in the front; and it does not matter whether the building has in the rear rooms that do not need light; the point is that you want air to perflate between rows of houses. This is invariably the rule in England where the $63\frac{1}{2}^{\circ}$ rule must be satisfied. In Bombay where two house sites adjoin one another we allow the house-owners to share a common $63\frac{1}{2}^{\circ}$ space; we only do that because of the extreme value of land in Bombay, and because we want to make things as easy as possible for the owners of existing buildings; but in England they would be horrified if they were told that there should be in the rear of the house a space of the breadth of only half the height of the house. In Birmingham and I think in all provincial towns in England you will find that a 40-foot house will probably have behind it an 80-foot space. In Calcutta I am glad to see they have insisted upon the $63\frac{1}{2}^{\circ}$ space being provided in each man's land, so that between two rows of houses there is a space as broad as the houses are high. I do not want people to go away with the impression that what I am recommending is what I consider adequate for all towns. It is what we consider in Bombay to be the *minimum* to be insisted on. Of course, if the $63\frac{1}{2}^{\circ}$ air plane rule be satisfied for one house, the $63\frac{1}{2}^{\circ}$ light plane rule is satisfied for the house behind it.

I hope we shall have some comments on the very difficult question of how far to apply new bye-laws to existing buildings. You will find in my paper a reference to what the Bombay Municipality are doing. I am extremely glad to say that a Committee of the Bombay Municipality, including the leaders of local public opinion, have agreed to the $63\frac{1}{2}^{\circ}$ rule being applied to all new buildings and they have gone so far as to say that in old buildings the method of application shall be roughly this, that when a man has to rebuild his house, he shall provide in the rear of that building half the air space required by the $63\frac{1}{2}^{\circ}$ rule. That is to say, if his house is 40 feet high he has to provide, not 20 feet, but 10 feet space in anticipation of his neighbour providing the other 10 feet when he has to rebuild.

The Hon'ble Mr. M. Ramachandra Rao introduced his paper, "Town improvement schemes and building bye-laws in the Madras Presidency."* The following is a summary :—

Legislation on the lines of the English Housing of the working classes Act of 1890 and 1909 would be a step in advance in bettering urban and rural life, but the increased powers conferred on local authorities would not be of much practical value in the immediate future, owing to differences in the financial resources of the local authorities in this country and in England. Local authorities in India cannot under existing conditions finance improvement schemes on the general lines laid down in the English Acts. An improvement in the sanitary condition of Indian towns is not possible till the solution of the problems

* Volume IV.

connected with the housing of the poor is taken in hand on the lines adopted in Western countries. This again depends largely on the financial resources of local authorities.

The English principle of betterment is too complex in its working, and could, in any case, only be applied to property of the well-to-do classes. To the poorer classes it might prove oppressive. Several improvement schemes are described to illustrate this point.

In Ellore, the town had benefited by improvement schemes, but in no case could the principle of betterment be applied. Funds were provided by local Government grants.

Municipalities should take action at once by acquiring land likely to be absorbed in any extensions of the town, and so obtain the benefits of any rise in values. Future building operations can then be fully controlled and suitable plots reserved for public purposes—schools, recreation grounds, etc.

The Government of Madras have laid down a set of rules for town extension schemes to which local authorities must conform. According to these rules, a very complete scheme has to be put forward and the rules will have to be relaxed so that while a large area may be acquired it will only be necessary to give a detailed scheme for part of this area.

The rules for the levy of ground rents in towns is also referred to. These are applicable to all town-planning schemes in the Madras Presidency. As any increase in the letting value of house sites is due mainly to the amenities and conveniences provided by the local authorities and at their expense, there is no reason why the enhanced rating values should not go to them. The Government should have nothing to do with the rating of letting values of house-sites, it should be left entirely to local authorities. Those who purchase sites under town-planning schemes have now to look to two authorities, the municipal and rural boards, who revise their rates once in every 5 years, and the Government who revise their ground rents once in 30 years, and both seek to fix their rates on the letting value of the land or site. This is altogether unnecessary. The system of ground rents should either be abolished or the payments should be limited to a fixed number of years.

Local authorities in this country have not undertaken any responsibility as yet with regard to those who are disturbed in consequence of any improvement scheme. In the Madras Presidency it has been the practice to make building ground only available to them. Applications for provincial grants in order to build dwellings for those of the poorer classes who have been deprived of their houses have been hitherto refused. The Madras Corporation has made a beginning and has built about 376 tenement houses for the poor at an average cost of about Rs. 350 for each tenement, from each of which a rent of Re. 1-8-0 per annum is realised. In the District Municipalities work of this kind has not been undertaken. The cost of a cheap dwelling house, according to the design made by the Sanitary Engineer, comes to about Rs. 340, an amount very much above the means of the very poor who require relief. The cost of the *katcha* hut now occupied by them is only about Rs. 30 or 40. The extreme poverty of the working classes in Indian towns is such that it is impossible for them to build their dwellings on an approved sanitary design. This point was raised in Madras by a motion in the Legislative Council last year, but the Government of Madras refused to do anything which would amount to a recognition of the policy of providing housing accommodation for the poor.

It does not solve the problem to spend money on the relief of congestion without at the same time providing sanitary dwellings for those who are displaced. The present practice of making provision of building sites is not likely to result in any improvement at all, as the same class of hutting will be constructed elsewhere. If it is not possible on financial grounds to provide dwellings for all who are displaced, some provision ought to be made in sanitary schemes for the construction of a few model

dwellings so that those who can afford to build may be able to follow good and approved designs.

In a consideration of town-planning schemes the constitution of Indian society, and its habits is a vital question and cannot be ignored; due provision should be made to meet them. Otherwise town-planning schemes will not be successful. Separate blocks for each class are desired and should be set apart.

Mr. Ramachandra Rao said:—I should like to make a few remarks illustrating the condition in Madras. There the problem is not so much congestion such as exists in Bombay, but some congestion added to the problem of the betterment of insanitary areas such as now exists in most provincial towns. As this Conference adopted a resolution about town-planning during its previous sittings, it appeared to me that it was appropriate to examine the question from the financial aspect of town-planning on the principles recommended by the English Act in those resolutions. It seems to me that if those principles of financing town-planning schemes are adopted in India, most of the provincial towns will not be able to finance the schemes at all. With the view, therefore, to see how far existing conditions would justify the introduction of these measures and the adoption of the financial proposals laid down in the English Acts, I have placed before the Conference details of some of the schemes carried out from provincial funds in Ellore. You will see from the details given that none of these schemes could be financed on the principles laid down by the English Acts. It seems to me, therefore, a matter worthy of consideration as to whether this Conference should recommend to the Government any other way of financing these schemes. In regard to this question of town-planning the most important consideration is the question of the dwellings for the poor. We have had large numbers of the poor living in the heart of the towns, who, from the insanitary conditions under which they lived, had to be removed to better localities, and the result was that all these localities were acquired at great cost, but the question of housing the people remained as far off from solution as ever. This is the great difficulty that we are faced with in the Madras Presidency, whether by the relief of this congestion and the acquisition of sanitary localities we are placing these poor persons who are turned out in better surroundings and better houses. In Madras the policy has been to clear large blocks of land for house building purposes, and place them at the disposal of persons who were turned out by town-planning schemes, but the Government have systematically refused to recognise the principle of providing house accommodation for those who were displaced by these schemes. It was stated that it is purely a matter for local bodies and the Government would not finance them or give provincial grants in aid of building houses for the poor who had been displaced by town-planning schemes. The question therefore arises for consideration whether this policy of the relief of congestion and the acquisition of insanitary areas is sound unless some provision is made for the housing of the poor who are dishoused in this way. Is it to be regarded as merely a matter of commercial concern or is it to be part and parcel of sanitary work? I believe, Sir, that, unless some provision is made either by better provincial grants or by increasing the resources at the disposal of local bodies, the question of town-planning will remain as far from solution as possible.

The speaker then referred to the paper by Lala Jai Lal on "Sanitary Improvement in Urban Areas" and observed that he (Lala Jai Lal) had complained that the Simla Improvement Committee had also the same financial difficulties as they had in Madras.

Another point on which he would like to place some insistence was town-planning in rural areas. In Madras they had 400 towns with a population of 5,000 and over, as shown in Appendix B of his paper. The ground rent payable on these sites was revisable every 30 years. These lands which were built upon were still regarded as

agricultural land for the purpose of raising ground rents. If it were a municipality, the letting value of the land would be revised every 5 years. The rules were complicated and required a great deal of consideration. The town-planning act as proposed in a resolution of the Sanitary Conference last year would apply to large towns, but it was equally necessary that in reference to small towns a set of rules, simple and equitable to all parties concerned, should also be introduced.

Another point in regard to town-planning was that social restrictions and the habits of the people had to be considered. They were still experiencing difficulty in this connection at Ellore in getting people who had been sent away from congested areas to accept sites acquired by the Municipality. Any scheme would be a failure unless the inclinations of the people were taken into account.

Mr. JAI LAL'S paper on "Sanitary Improvement in Urban Areas," * and Mr. K. Iyengar's paper on the "Bangalore City Extensions" * were taken as read in the absence of the authors. The following is a summary of Mr. Jai Lal's paper:—

The position and powers of municipal bodies is defined and discussed with reference to the control over construction of new buildings and necessary improvements of existing ruinous or insanitary buildings.

The limitations of the Punjab Municipal Act, III of 1911, are set forth and administrative difficulties are pointed out. For example, in the case of a ruinous or insanitary building, which nothing short of rebuilding or reconstruction can remedy, municipal committees are bound to give the owner the option of either removing it or repairing it, and that the repairs should be specified on the legal notice. This throws undue responsibilities on the committees. Again, municipal committees are powerless to take action regarding insanitary buildings occupied for purposes other than human habitation.

These defects should be remedied and in cases of conflicting interests, sanitary considerations should override all others.

As regards land acquisition to relieve congested areas:—

(*a*) all schemes should include provision of accommodation for people turned out and whose houses are acquired or demolished,

(*b*) owners of adjacent property or land who benefit by improvements should contribute to the cost of such improvements in direct proportion to the benefit they receive,

(*c*) procedure under the Land Acquisition Act should be shortened and simplified, and land acquisition officers should be empowered to take into consideration, when awarding compensation, the ruinous or insanitary state of buildings or property,

(*d*) disputes should be settled quickly and finally by arbitration and no hard and fast rules laid down,

(*e*) municipal bodies should be empowered to issue debentures or form improvement trusts to provide funds for reclamation of insanitary areas, and without the necessity of asking for special legislation.

MR. K. IYENGAR'S paper on the "Extension of Bangalore City" * is summarised as follows:—In 1892, improvements and extensions of the town of Mysore were undertaken and proved so beneficial that, in order to minimise the excessive overcrowding, similar efforts were made in Bangalore, and the Chamarajendrapet extension was built to the west.

When plague broke out in 1898, the evils of overcrowding were accentuated and further extensions took place to the north and south of the old city. Recently a fourth extension, linking up those on the west and south, has been opened out.

* Volume IV.

The author discusses the geological formation, topography and climate of the area and their bearing on the choice of site for, and lay-out of, the extensions.

The total area of the four extensions up to date is 1,089 acres, which, with the area of the city proper, 666 acres, gives a total extent of built area of 1,755 acres.

The extensions are all laid out more or less on the gridiron or chess-board plan. In only one, the Basavangudi extension, are added four diagonal roads terminating at the four corners of a public square in the centre of the extension.

The approach roads are 100 feet wide, and other roads vary from 40 to 60 feet. Each row of houses is divided by a narrow conservancy lane, 12 to 15 feet in breadth, and these lanes form a distinguishing feature of the Bangalore extensions.

The designs adopted, though unimpeachable from a sanitary point of view, give a stiff and monotonous appearance. Due regard has not been paid to natural features, and consequently there is a lack of beauty of perspective and variety of landscape. In all subsequent extensions this should be borne in mind, and natural features taken advantage of.

The storm water drainage, sewerage, and water-supply schemes were not completed before people were allowed to build houses on the sites. This was a serious mistake, and in all future extensions these works should invariably be included in the estimates and completed first.

The paper concludes with a description of the drainage and sewerage arrangements of the extensions, their defects, and the improvements still required.

A map of the four extensions, a diagram showing sections of roads and conservancy lanes, and general plans of house connections and drainage works accompany the paper.

Rai Bahadur Ganga Pershad Varma said he had read Mr. Orr's instructive paper and heard his address with great interest. He agreed that the $63\frac{1}{2}^{\circ}$ rule should be adopted in all cities, but pointed out two difficulties which occurred to him in Upper India. These were (1) that if they insisted on house-owners, when they rebuilt their houses, leaving a 10 feet lane behind, the first thing asked for would be compensation. The second difficulty was that if 10 feet were taken away from houses which generally had a width of 40 or 50 ft., it would not be possible to have a zenana house suitable for Muhammadans in Upper India. He would like to know how these problems had been solved in Bombay. If they could be solved, the question of relieving congested areas would be solved, but as far as Northern India was concerned this was a great difficulty.

Rai Sahib Wazir Singh did not think that the $63\frac{1}{2}^{\circ}$ rule could be of universal application and thought it would depend upon the physical and local conditions of the place as to where it could be applied. He instanced Delhi where one-storeyed buildings would be unbearable in the hot weather. In Saharanpur, Meerut, Delhi and other adjacent places it was the custom to have large chowks in the middle of houses, and these were used on the occasions of gatherings at a funeral or marriage, and serve the purpose of a chimney. These chowks were also to be found in Lahore, Amritsar, Ludhiana and Ferozepore, and it may be proper to apply the $63\frac{1}{2}^{\circ}$ rule to these places. Again in Delhi they had what may be called the right of privacy. If there already existed a house two-storeys high, and the municipality only permitted a one-storeyed house adjoining it, the owner of the one-storeyed house had the right to bring an action against the owner of the other house to have all windows closed so long as they overhang or overlook his house. Another question also had to be considered. When the population increases there are only two alternatives, either to give them land to build, or to increase the storeys of houses. In Delhi there was no alternative but to increase

the number of storeys so as to give place to newcomers. In Delhi the ground floor of a house is seldom used for residential purposes. The application of this rule would operate hardly in these cases, and this could not be justified on grounds of sanitation alone. From Mr. Orr's paper it would appear that he allowed a house to be double the width of the street in height in cases where there were no chowks. In Delhi the first storey is generally 12 to 16 feet high, the second storey between 10 to 12 feet, and the third storey, called a Barsati, is a small room used in the rainy season. The womenfolk and family take the air each evening on the tops of the houses, and pamchajjas, and the prohibition of high houses would affect their health. He thought that the physical and other conditions of a particular town should be taken into consideration before making such a rule universal. This rule will affect very seriously the value of urban immoveable property in Delhi and there are many persons in Delhi who live solely upon income from rents.

MR. KENT:—I should like to congratulate my friend Mr. Orr on his interesting and instructive paper. I read his paper with feelings of pleasure and admiration mingled with a little disappointment. Feelings of pleasure, because I was brought once more in contact with a subject with which, as Engineer to the Bombay Improvement Trust for some years, I have considerable experience. Admiration at the extraordinary industry and painstaking ingenuity of Mr. Orr in producing this remarkable paper which must have taken up a very great deal of his time, and which is, to the scientific man and the expert, certainly very instructive. There is a certain amount of disappointment at the way in which the subject has been treated. Mr. Orr, we know in Bombay, is very thorough, and everything he touches he usually sees through. He has unfurled his banner in Bombay, his gospel is in his hand, and his disciples are collected round him, but it seems to me that his gospel of which the paper presented to the Conference is only a chapter, is a little too complex for simple men. If a man wants to move multitudes he must preach a simple creed, and I think in the paper that we have before us, there is just a chance of the wood being obscured by the trees. That, I think, is a pity. The paper is full of meat, but 'tis a trifle indigestible. As regards this $63\frac{1}{2}°$ rule, the essence of it is as shown on the blackboard, *viz.*, that if you have two houses side by side, then the space between the two houses should be one-half the height of the taller house. That is the rule in its essence. Of course, as Mr. Orr points out, it is to be applied in a variety of ways, and conditions, but those are matters which ought to be left for the executive officer and the expert, and need not concern the man in the street. If you tell him that when there are two houses adjoining, the space between the two should be one-half the height of the taller house, he will understand you; but if you befog his mind with an immense amount of detail the matter will cease to interest him, and possibly alienate his support.

Mr. Orr has told us in his interesting paper that the building bye-laws of the Bombay Improvement Trust are based largely upon the very valuable work that was done by the late Mr. Harvey. Everybody who knew Mr. Harvey as Municipal Commissioner of Bombay had the very greatest admiration for him and his thoroughness, and it was he who really went to the root of the sanitary problems in Bombay, and in his practical mind formulated a number of suggestions which we in the Improvement Trust have endeavoured to put into shape, in the form of bye-laws, and the $63\frac{1}{2}°$ rule is more or less based on his suggestions. We do not consider the $63\frac{1}{2}°$ rule altogether sufficient, but having regard to the enormous value of land in Bombay, we have not found it possible to adopt anything more stringent. We regard this $63\frac{1}{2}°$ rule as the sheet-anchor of our bye-laws. People have tried to tamper with it but we have stood up against all opposition and I believe it is now universally admitted to be a very admirable sanitary rule. At one time before this

rule came into existence, there was a sort of rough rule that only one-third of a plot of land need be left as an open space, *i.e.*, two-thirds might be built upon. But that rule might operate harshly or it might operate in a manner prejudicial to sanitation. It is possible to design a house which will not cover more than two-thirds of the plot and yet at the same time be hopelessly insanitary. The $63\frac{1}{2}^{\circ}$ rule operates everywhere on Trust Estates and I have no doubt it will even meet Delhi conditions.

I very much regret to see a proposal in Mr. Orr's paper to reduce the $63\frac{1}{2}^{\circ}$ angle rule to one of 68°. I think that the $63\frac{1}{2}^{\circ}$ should be the irreducible minimum. That angle is more obtuse than the angles adopted in Liverpool and various other towns in England, and any lowering of this standard I view with dismay. In one para there is a municipal bye-law to the effect that in the case of chawls, *i.e.*, buildings for housing of the poorer classes, there should be greater spaces left between buildings than in the case of the better class of buildings. Nobody is able to understand that anomaly, and Mr. Orr touches on it in his paper. It seems strange that when buildings are designed for the working classes who are supposed to be dirtier in their habits than the well-to-do, they should have greater open spaces. The more well-to-do a man is and the better he is educated the more space he likes about him, so there can be no valid reason for insisting on the provision of greater space for chawls and houses of that sort, than for buildings for the superior classes.

On plan No. 10 there is a proposal to cut off the backs of buildings and remodel them. Plan No. 10 is typical of many of the grossly insanitary areas in Bombay. You will see there two lines of houses abutting on streets with a very narrow space separating them at the back. This is the service passage which it is difficult for a sweeper to enter except sideways. That space is about 2 feet wide. The idea is to widen that out to get a 20 foot space at the back: that means cutting off the rear of all these houses, and as it is in the rear of these houses that the latrines and the washing places are generally located, it would result in such houses being deprived of these necessaries. Of course that involves the remodelling of the house. It means pulling down a part of the house and adapting it so as to include latrines and washing arrangements. I do not know whether Mr. Orr's suggestion is that the cost of doing this should be borne by the public body concerned or whether it should be borne by the owner. I think that public funds should not be spent on works of this nature. I think the laws require revising so as to enable public bodies to insist upon these insanitary defects being removed at the expense of the owner. Bodies like the Improvement Trust should be concerned in big schemes, laying out roads and big areas and in developing new land; but their funds should not be squandered in doing things which ought to be done by the owners themselves. These people rack-rent their tenants and it is only reasonable that the cost of improvement should fall on them.

I should like just to make a few remarks on Mr. Jai Lal's paper on Simla. I always thought Simla was a sort of Elysium for the gods and was not aware that it had its dark, insanitary sinister spots, but apparently it has. It is very evident from the account given in the paper that some well-considered scheme for the lay-out of all Indian cities should be worked out. You must not deal with one little area, the city must be tackled as a whole. All schemes of improvement should be well-considered schemes and it is no good tinkering with little bits of a town. Mr. Jai Lal says:—"In my opinion it is a great mistake to start on a campaign of acquisition and demolition of buildings in congested areas without first providing for the suitable accommodation of the persons occupying such buildings. If this is not done the very act intended for relieving congestion defeats its own purpose."

That is so : there is no question about that. We have had just the same trouble in Bombay city and I think we might have been given a little credit for what we have done in the Trust to mitigate the hardships of displacement, but perhaps the writer of the paper did not know what had been done in Bombay in this connection. In recent years we have systematically provided accommodation. I don't say it has been sufficient in every case, but before tackling a new scheme we have built what we call semi-permanent camps for housing those that are displaced owing to our operations. We have a very simple form of camp. The sheds are all built of corrugated iron and in such a way that there are no holes bored in the sheets which are kept together by clips. This is put on a simple foundation and the whole shed can be rapidly taken to pieces and put up in another place when its removal is found necessary. In another place in his paper, Mr. Jai Lal says: " If the site is left as an open piece of ground between other houses it comes to be used as a dumping ground for the filth and rubbish of the neighbouring houses and is thus a source of nuisance."

That is so. I think open spaces might conveniently be divided into three sorts. To begin with you have the small open space. In every area of the city you want a certain number of small open spaces as they have in Germany and other towns on the Continent, where children can go and play near their homes under the eyes of their mothers. Those places, in the larger towns, should be tarred so as to present a clean sanitary dustless surface, and where possible gymnastic apparatus or something of that kind might be provided for the children to play with. These places are found very necessary on the Continent and they fill a very greatly-felt want in keeping children off the streets. Another type of open space is large recreation grounds and parks. They are intended for youngish people, for sport and recreation, as well as for the general public. There is a third kind of open space which has come into favour, particularly in America, and that is what is known as parkways. Along the big avenues and boulevards, a wide shady space is left running parallel to the road, 40 or 50 feet in width. This forms a continuous amenity, and as the tramways are frequently laid alongside, the convenience to the travelling public is very great. The next paragraph deals with betterment which is a very thorny subject, and which meets with an enormous amount of opposition, as it is bound to. It is very difficult to know how to assess the value of betterment. This problem will no doubt be tackled in time in Bombay and Mr. Orr will very likely have something to tell us on the point presently.

In Mr. Iyengar's paper a good deal of attention is paid to the subject of the laying out of cities, and he explains the type of lay-out that has been adopted for the Bangalore City extensions. We have there what is known among town-planners as the chessboard or gridiron plan of lay-out. It seems to me that the man who laid out the extensions of Bangalore had made up his mind that the only way of laying out a city was by dividing it into a number of plots by roads at right angles to one another. That type of lay-out may be very suitable on a flat plain. It is a very desirable type of lay-out in business areas where you want well-shaped plots for shops etc., but if traffic is to circulate in the most direct manner, a certain number of diagonal roads running through the lay-out is essential. When you come to the suburbs of a city where land may possibly be undulating, then formal rectangular type of lay-out is absolutely useless. I think you must follow nature to some extent. You must study the contours carefully and make use of the levels for aligning roads and drainage works. Then there is the æsthetic point to be considered, it is one frequently neglected, in this country. The question has been taken up at home, and on the Continent one sees the most delightful treatment of undulating areas. The lay-out by the new capital of the Australian Commonwealth is a fine example of the most up-to-date treatment of

the lay-out of hilly country. But for town-planning schemes of any kind to be successful the collaboration of engineers and architects is essential.

The Hon'ble Mr. L. Porter :—I should like to say one word. I think 15% is paid for the acquisition of insanitary properties all over India except in Calcutta and Bombay. There are special Acts with regard to this.

The Hon'ble Mr. J. P. Orr :—In connection with what Mr. Kent has just said about the development of undulating areas, may I pass round a plan of the development of what we call the garden suburb of Bombay, which is largely due to Mr. Kent's genius ?

Mr. E. G. Turner :—I should like to say a few words on the paper by the Hon'ble Mr. Ramachandra Rao.

The paper deals more with the improvement of existing conditions in a town rather than providing for its future extension. The schemes explained are mainly housing schemes, and not such town-planning schemes as are actually being prepared under the English Town-Planning Act. It is stated that none of the schemes mentioned in the paper could be carried out if they were to be financed on the principle of betterment. This may be so, and the local authorities concerned would naturally consider this point before resolving to carry out the improvements by applying the provisions of an Act which gives them power to charge for betterment. It is not always thought desirable in England to use the Town-Planning Act, even when it would be more convenient to apply its provisions, and sanction has been refused to the preparation of some schemes on the ground that it would be better to proceed under the ordinary powers of the Public Health Act. One great advantage however in having an Act that allows a local authority to claim for betterment is that it arms them with a strong weapon with which to combat claims of compensation for injury. The result is that an agreement is usually effected between the local authority and the owners concerned, and the success of a town-planning scheme is assured if there is agreement between all parties. I have come across no case in England in which a claim for betterment by a local authority under the Town-Planning Act has had to be referred to arbitration. Agreements in all cases have so far been effected.

A good point is made in stating that Municipal finances in India need examination with a view to bringing them more into line with the conditions in the West. In the Bombay Presidency, a Mofussil Municipality has to " cut its coat according to the cloth," and it is not found easy in practice to raise the taxes. In the case of town extension schemes it is most important to secure land whilst it is cheap. Municipal funds are generally small and hardly suffice for present needs, so that the interest on capital borrowed to carry out a promising scheme is best obtained by a slight increase in taxation. Ample return will be obtained if the scheme proves a success. In England the local rates can be increased or decreased without limit by a mere resolution of a Municipality, and in Scotland the general rates can likewise be increased up to a limit of 1/- in the £ on the assessable value. It would considerably help local authorities in India to improve and lay out their towns, if they could impose taxation up to a certain limit to meet the expenses of loans required for promising housing and town-planning schemes, when once such schemes have been finally sanctioned.

The purchase of land in advance of development is also recommended. In England the local authorities are not very keen in this matter, but German Municipalities buy largely, and as an example of the extent to which they use their powers it might be mentioned that about 70 per cent. of the land in the fairly large town of Ulm belongs to the local Municipality.

It is suggested that if local authorities are permitted to make proposals for the acquisition of building land to meet not only present

but future needs for the next 20 or 30 years, and be allowed to confine proposals for constructional works only to the extent to which they may be immediately necessary, there will be a better chance of the local authorities undertaking these schemes. This suggestion describes exactly the manner in which the Draft Bombay Town-Planning Bill will allow a scheme to be executed. A large area can be planned and all the land required, whether immediately or in the future, is either obtained at once by the local authority, or reserved for the purpose for which it is required, and from time to time, schemes dealing with constructional works in different portions of the area can be taken in hand as the course of development demands.

MR. G. P. ROBERTSON :—It is rather difficult to apply the $63\frac{1}{2}°$ rule in Darjeeling where houses are built on the slope of a hill. In Darjeeling we have had many cases in which large bustees have arisen from small beginnings. People received permission to build huts. These huts in course of time develop into two-storeyed buildings, and in a very short time it becomes impossible to deal with them. There are several places of that sort where there are neither drains nor roads. In this connection I would like to see a clear definition of the word "hut" and the definition should include a two-storeyed building of the kind which is practically a hut. Then with regard to the question of houses for people displaced. In Darjeeling if they are taken too far from the town the price of labour increases considerably.

In Darjeeling small open spaces are looked after by the Darjeeling Improvement Fund which is under the control of the Deputy Commissioner. The Curator of the Botanical Garden is in charge of these areas and they are kept in very good order.

MAJOR C. H. BUCK :—As regards general building bye-laws, many of them are fairly satisfactory, but the difficulty is to enforce them and to induce members of local bodies to apply them correctly.

In second class municipalities it is desirable to instruct the municipal sub-overseer or mistry, who is generally employed to prepare private plans, so that he will prepare them on proper principles.

At an ordinary municipal meeting one has not time to go into details and to properly deal with the numerous plans sent in. As a matter of fact, in petty towns the method of building lies entirely in the hands of the municipal sub-overseer or mistry.

I also wish to make a few remarks on the reflection of light by whitewashing outside and inside of walls. Whitewash is very cheap and it has a most marvellous effect when applied to otherwise dark houses and streets. Take an ordinary existing shop in a bazar ; there is a front room fairly lighted (provided the street is broad), a middle room rather dark, and a back room, which is sometimes almost pitch dark. Whitewash the inside walls and one can read in that back room. The importance of light to human health is well known, but I may mention that my brother, who is a surgeon of two hospitals in Brighton, once carried out experiments in the wards to see the effect on patients by changing the position of their beds ; the statistics which he obtained showed that even the slight variations of light within a single room had a decided effect on the rate of recovery of patients. I think, therefore, that our building bye-laws should always include rules for white or colour washing.

DR. LANKESTER :—I should like strongly to support what has just been said about the value of light and about the extreme facility of securing it by the simple method that has just been mentioned. Again and again one has seen in practice dark rooms right in the middle of a city, where a few annas spent in whitewash would make all the difference between light and darkness.

There is one other point as regards town improvement upon which I would like to lay emphasis, and that is the tremendous importance of pucca paving of narrow gullies. Anyone who is constantly in and out

amongst narrow gullies in the middle of a city is continually forced to see the great difference which there is between those gullies which have a pucca paving and those which are left unpaved. There is first the difference of cleanliness, they can be easily flushed every day. There is the absence of mud, and there is what is perhaps more important still, the fact that on one of these pucca gullies you can see in a moment whatever filth has been deposited, whereas in the ordinary mud, unpaved narrow passages, they go from bad to worse. When there is bad weather they become muddy, filth can be deposited on them and no one sees it, and they are frightfully offensive in hot weather. More than that, the possession of one of these easily cleanable streets seems to raise the social status of the whole *mohalla* or quarter. You get a better class of inhabitant coming to them. The houses themselves are improved and it seems to raise the whole tone of that particular *mohalla*.

Of course as an outsider one is impressed by the great difficulty which all house-planning experts must be faced with, how long are we to wait before these great improvements are to take place ? We cannot encourage fires, most admirable as fires are when they do occur. The chief improvements in the city that I am connected with, date almost entirely from two very disastrous fires that have taken place during the past year, but something may surely be done in the way of encouraging public opinion on the part of the large owners. I would suggest that only those Indian gentlemen should ever be put on municipal committees who themselves are willing to make sacrifices in the direction of seeing that their own property is above suspicion in this matter. There ought to be an end of what is constantly taking place, the stultification of all the plans that are put before the Committee by experts, because possibly the President or the most wealthy member of the Committee is there, and nothing can take place so long as he sits on that Committee. We need to have the best, not the richest, but the best and most truly advanced Indian opinion with us in these matters, and, gentlemen, I am perfectly certain that if we look for it in the right way, if we honour those who really are worthy of honour, we shall get that best and most advanced opinion on our side all through.

The Hon'ble Mr. Ramachandra Rao brought forward the importance of providing suitable dwellings for the poor who are displaced by such schemes as have been mentioned. The shelter scheme heard of in Bombay is admirable so far as it goes, but it is feasible only temporarily. Its importance is great because it is one of the cases where we have to guard against improvements, which may have as their sequel inevitable overcrowding, and which may really make the remedy in the end worse than the disease. The remedies are difficult, but perhaps one might mention two, one being the encouragement by heads of Government of philanthropy in the direction of large building trusts such as the Peabody Trust, and many other immense trusts in London, which have provided accommodation for hundreds of thousands of the poor in congested districts in London. Every head of Government in the different Presidencies is approached from time to time by wealthy Indians who are ready to give liberally, and are quite ready and indeed anxious for some direction to be given them, as to how best their money shall be spent. Might one dare humbly to put forward the proposal that the suggestion be made to generous donors to make gifts that will benefit their own fellow countrymen in a large and wide manner like that, instead of building splendid edifices that will look well in the most prominent position of the city. Further, investors in building schemes might be encouraged, if it were possible, by generous offers as regards Government or municipal land in or around cities. There is no question at all, I suppose, that the building of sanitary accommodation on a large scale would be a most excellent investment to companies who care to use their money in that way and

it may encourage them to do so if they could have generous treatment as regarding building sites.

MAJOR C. H. BUCK :—There is another matter which I forgot to mention and that is the existence of sanitary rules in the various religious books of the people of India. Many of these rules are most excellent and if suitable ones were extracted and impressed on the people, they would have a great effect in improving sanitation generally. At the time of Diwali, for instance, much can be done in this way. I think it would be desirable for an officer to be placed on special duty to prepare such extracts. These, in the hands of district and sanitary officers, would be extremely useful.

MR. MOORE :—In regard to the rear open space insisted on by Mr. Orr, I think it would be well to leave out the word " rear," as in the type of houses commonly met with in Madras there is an open space in the centre, and as long as the house is not too high it is quite sanitary. He thought it would be a mistake to adopt a system which was not in accordance with local customs. He enquired whether Mr. Orr intended that the rules in regard to air space should apply to non-residential buildings as well as residential buildings, because if they did not, a non-residential building might make the residential building next door to it entirely insanitary from the point of view of excluding light and air.

In regard to Mr. Rao's complaint that the Madras Government were not willing to give money for the building of houses for the persons who were dispossessed by improvement schemes, he pointed out that the Local Government was bound to refuse such a request, as such schemes had to be made self-supporting. If they were not self-supporting then their scope would be so limited as to be of practically no value. Model dwellings could only be constructed on a small scale and to serve as models.

He entirely agreed with what Dr. Lankester had said as to encouraging Indian philanthropists to invest their money in building schemes and thought that, with personal influence, a great deal might be done in that direction. Something of this nature had been done in the station of Bangalore, for the improvement of which they had been given one lakh of rupees by the Government of India, and for every rupee they had spent, two rupees were spent by private Indian gentlemen, so that three lakhs were spent. He thought much could be done by enlisting the sympathies of intelligent Indians in this manner.

MR. G. N. SAHASRABUDHE :—As a layman I would support the proposal of including " whitewashing " in the House Building bye-laws, but " whitewashing " may include whitewashing not only by chunam but by white earth or " safeyd mutti. " All of you must have seen that in villages some houses are kept clean by poor people by whitewashing their houses with white earth, so that the poorest of the poor will be able to white-wash their houses.

MAJOR BEADON :—I should like to ask Mr. Orr one little point of detail about this system that they have in Bombay of insisting on what I may call " set-back " lines. The Punjab Municipal Act under which we work in Delhi, lays down that the Committee has power to institute set-back lines, but unfortunately that section also has a proviso which states that a man may be ordered to set his house back only provided the Committee give him sufficient compensation. That is rather an important point and I should be very much obliged if Mr. Orr will tell us whether his schemes provide for financing such improvements. I think we probably all of us agree with what he has said on the subject of light and air, and so forth.

We have two matters to consider, one is the question of new schemes for which rules have to be drawn up, and the other is the question of improving our existing insanitary towns. I think certain parts of Delhi must be admitted to be extremely insanitary, and I am

very sorry to say that the Capital of India possesses no building bye-laws at all. There are some building rules but they can hardly be described as bye-laws. I want to emphasize the great difficulty one has, not only in getting bye-laws, but in getting them enforced when they are passed. My experience in Delhi has been that we have had great difficulty in drawing up suitable bye-laws.

In regard to building lines, one of the first things necessary, I think, in our towns, especially in old towns, is to lay down a building line and to get people back to that building line. This is the only way in which you can prepare the way for the Improvement Trust. When it comes along, you have done a little towards improving the place and the result is that the work of the Improvement Trust Committee if it does come, is a little easier. In this connection I think that every such Committee should take the map of a town and begin by marking on that map the set-back lines to be adopted in future.

Major Beadon then referred to the subject of playgrounds. In Delhi they had really no playgrounds at all and it was pitiable to see the children of the place playing about in the streets for want of other open spaces.

In regard to the question of financing municipalities he pointed out the great difference in the methods adopted in England and in India. In India it was customary to have a number of different taxes and total these up when collected, and thereupon draw up an expenditure budget on that basis. If there was not sufficient money to carry out all the improvements those improvements were left undone. In England the custom was just the reverse, the expenditure budget was drawn up first and they knew how much money they required; they had only one tax, the house-tax, and they merely put an extra twopence or threepence on the house tax and so got the money. He was confident that they ought, in financing Indian municipalities, to insist on having a flexible tax which could be increased when money was wanted for necessary improvements.

THE HON'BLE MR. RAMACHANDRA RAO referred to the question of financing municipalities which had been mentioned by Mr. Turner. In Madras the tax was 16⅔ per cent. over the rental value and several municipalities had exhausted their resources. Out of 63 municipalities only 19 were provided with water-supply schemes, and none of them with drainage schemes. The margin of taxation was so small that unless substantial help was given to municipalities from Provincial or Imperial funds it would not be possible for these municipalities to finance drainage schemes.

In regard to model dwellings he mentioned that the design of a cheap dwelling-house furnished by the Sanitary Engineer to the Madras Government cost Rs. 456, whereas the cost of a kutcha hut put up by the poorest class of persons in Madras was only 30 or 40 or 50 rupees. He thought it was, in these circumstances, impossible for the municipalities to undertake to provide dwellings for the poorest classes, and unless that question was faced town-planning would stand where it was.

In regard to what Mr. Moore had said, Mr. Rao said his point was not that the Madras Government was not sympathetic, but that the problem was not within their power. It was for that reason he had mentioned the matter at this Conference so that they might bring their difficulties before the Government of India.

He was glad to know that Mr. Turner approved of the idea of acquiring all the available ground in the neighbourhood of towns for improvement purposes. If the question of financing improvement schemes could be at least partially solved, it was only by acquiring all such available ground, as early as possible even before the work of removing congestion commenced. He suggested that a resolution might be adopted in favour of the acquisition of land in the neighbourhood of towns, before the demolition of houses in insanitary areas was

undertaken, and that Provincial and Imperial grants be devoted to that purpose.

There was another point, that in regard to providing playgrounds for children referred to by Major Beadon from Delhi. Schools were distributed all over Delhi and they required a great deal of money in order to provide gardens or open spaces for the children.

THE HON'BLE MR. J. P. ORR in replying said : –I observed that in some of the remarks that have been made it seems to be the impression of the speakers that what I have recommended is the adoption *in toto* and everywhere of the $63\frac{1}{2}°$ rule as in force in Bombay. That, of course, was never my intention. I am glad to hear other speakers recommend that local conditions should be taken into consideration. Of course in a huge continent like India one must recognise that local conditions will vary enormously, and what is suitable for one place may not be suitable for another ; and yet I hope that there may be found no necessity for distinction between one place and another in the adoption of the *principles* underlying the $63\frac{1}{2}°$ rule. There are some very big questions raised which I fear would involve separate lectures of half an hour each, and I would recommend that some of them be brought up at the next Conference after people have had time to consider them in relation to their several towns.

Taking the Hon'ble Mr. Ramachandra Rao first, he has had a great deal to say upon the question of providing for the people to be evicted before actually acquiring their land. That, of course, is a very difficult question and one upon which we have had experience in Bombay and in fact it is a point in respect of which we plead guilty to having made mistakes in the past, by which mistakes we hope other people will benefit. It is true that in Bombay, as I believe in parts of Madras, the result of turning people out of their houses has been that the neighbouring parts have become overcrowded, that rents have consequently gone up, and when those parts had to be acquired acquisition had to be paid for on the basis of those enhanced rents. I will tell you something of what we have done in more recent times to try and escape this difficulty. In the first place, we have now reached in Bombay a stage at which the rise in rent has been checked. The supply of accommodation is exceeding the demand, and we now have no difficulty whatever in seeing that people are provided with rooms when we acquire houses, because our policy now is, not to evict immediately after acquisition, but to leave people in possession of their houses for as long as we possibly can, and to turn them out block by block as we require the different blocks for development.

We keep a register in which is recorded what room has been offered to each man a couple of months before he has been evicted from the room we want to demolish. We find that about half of them take the rooms we offer and half of them go elsewhere. I have tried to find out whether now-a-days this results in overcrowding and my general impression is that it does not, because sanitary building has been encouraged in recent years in Bombay ; that indicates the policy which I think should be followed everywhere. You want, on account of that provision of the Land Acquisition Act which says that the date of declaration is the date on which you value a house, to notify for acquisition as early as possible ; but having acquired your properties you need not at once evict the inhabitants of those properties. What we do is to pick out the worst of those properties here and there, and evict the people from those, and we put up for those people that we cannot find rooms for elsewhere, semi-permanent camps, a type of which I have brought here and will explain to anybody who wishes to inspect it. The advantage of these semi-permanent camps is this : as Mr. Kent has described to you, they are put up in such a way that the material of which they are composed can at any time be taken out of the building and is available for use. We never

make holes in our corrugated iron sheets. I have here a statement of our finances for these houses. They cost us Rs. 150 per room, and after allowing Rs. 5 per square yard as the cost of the land, a cost which, I suppose, is much more than you would have in many other towns, we still make a profit of 4·7 per cent. upon rents of Rs. 2-8-0 per room. Now Rs. 2-8-0 can always be paid in Bombay. There we have quite a different state of affairs from what exists in Madras and Cawnpore. I am told that people there cannot afford to pay very much more than 8 annas per month. If that is so, what is required is a general increase of wages which, I suppose, all town-planners foresee must come and has to be faced. We make a return of 4·7 per cent. in Bombay upon the money that we put into these semi-permanent camps, and if you regard the land as of no value you get a 9 per cent. return. So that people adopting that form of semi-permanent camp in places where land is of less value than in Bombay, may find that they will get a return of something like 4 per cent., 4·7% just covers what we have to pay on interest on sinking fund.

The Hon'ble Mr. Ramachandra Rao has said he thought Indian municipalities should acquire all land in the course of development before they start any scheme. I am afraid our experience does not lead me to encourage him. It may be all right in particular places, but in Bombay we have found it very doubtful. We still do not know; it is a matter to be settled later on when our lands are fully developed; but although we acquired land in the north of the Island at from one to two rupees per square yard which is very low compared to Rs. 25 per square yard which we had to pay elsewhere, we do not expect to be able to make a profit on that because of the great cost of preparing roads and filling up the land, etc., and what is more, and what a great many people do not take into account, the loss in interest and sinking fund charges that occurs in the interval between acquiring the land and spending the money in developing it and being able to lease it. I quite sympathise with the Hon'ble Mr. Ramachandra Rao in his exposition of the difficulties in Madras, because Government let them have land at a rent which is liable to enhancement in the future. You want certainty as far as you can get it in all these enterprises, and that uncertainty would debar private enterprise to some extent. It might be possible for the Madras Government to let the municipality wanting land for the purpose of erecting temporary homes for people they wish to evict, have the land for twenty years at a nominal rent and return it to them afterwards. Then you ask what is to be done with people who have been put there during those twenty years. You may hope that, as has happened in Bombay, private enterprise encouraged by the measures that sanitarians are taking to depreciate insanitary property and appreciate sanitary property, will have provided sufficient accommodation for the people who have been temporarily accommodated for twenty years in semi-permanent camps provided by the municipality. I might mention that in Austria there is a very large business done in that direction. The Government relieve builders of taxes for ten, twenty, or even thirty years, on condition of their erecting buildings of a certain kind and letting them out at certain rates to poor people.

Rai Ganga Pershad Varma raised a point about how far the cutting off of the rear part of a building might affect the value of the rooms: that is a difficulty. You may, as he says, cut off ten feet from a house and the remainder may not be sufficient for the man to make any practical use of it. I do not see that there is any help for that except in such a case, to acquire the whole house and use the plot so acquired for extensions of neighbouring houses, which is what we are proposing to do by way of experiment in Bombay. Perhaps next year or the year after I shall be able to give you the results of our actual experiments in this direction. The general idea is that if you have to

cut off so much of a house that the remainder is of no value, the owner of the house shall have the right to force you to acquire the whole.

Rai Sahib Wazir Singh seems to have misunderstood me. I gather that he thinks that the 63½° rule gives a man the right of light and air over his neighbour's property. Of course nothing of the kind is intended. You tell a man who is building a house that he has got to provide sufficient open space round his house, and primarily that space is expected to be within his own holding. If he can get a neighbour to agree with him that he may use his land for the purpose of his open space, well and good; otherwise you require a man to find that space within his own holding: you certainly would not give him rights over anyone else's property. Then he asked about the cases in which ground floors are not used for residential purposes. If he will look at Appendix B of my note, he will find that that question has been fully treated there. Where the ground floor is not used for residential purposes it is not necessary to apply the 63½° light plane rule. The light plane rule, as defined, is for residential quarters only. It is only the rear air plane rule that is applied both to residential and non-residential quarters.

I may take up what Mr. Moore remarked about this. He said that you might apply your rules to a residential building, but if you did not apply them to a non-residential building next door you might entirely spoil the residential building. That is so. If you have a non-residential building on a plot you might spoil a residential building on the next plot if you did not leave sufficient side open space. If a house is 60 feet high and has a non-residential building next to it, that non-residential building may be built right up to the edge of the holding; but we require the owner of the 60 feet house to leave 30 feet in his own land. The residential house is 60 feet high and must have a side space of 30 feet. That will sufficiently ventilate his rooms even if the non-residential house is built right up to the margin. But we do insist upon the rear open space satisfying the 63½° rule, even in a non-residential house. The other question raised by Mr. Moore was as regards whether you should enforce the rear open space in places where the custom is to rely entirely upon interior open spaces for the lighting and ventilation of the rooms. That is a great difficulty which occurred to me at once when I saw the type of buildings in Lucknow. But Mr. Moore says, why should you bother about other buildings if the interior open space is sufficient for light and ventilation. If you look at the statement of the principles upon which these rules are based, you will see that the 63½° rear air plane rule is devised with the object of securing perflation of air *behind rows of buildings;* and if you do not apply that to all buildings, you would have non-residential buildings obstructing that passage which is left for perflation of air between rows of buildings. You must apply that rear plane rule to non-residential buildings as well as residential. That being so, it becomes somewhat difficult to take the case of buildings in places where it is customary to rely upon interior air spaces. I can only suggest that you will have to insist upon the house sites there being larger than they are in other places, and if you so reduced your house site by requiring the back part to be left as an open space, as to leave no room for an indispensable interior courtyard, I am afraid you will have to acquire the whole site. I can quite realise that may be a difficulty which is insuperable here, and will require one of those modifications of the 63½° rule as applied to Bombay which I recognise as essential. In that connection, too, I may speak about the hill station difficulty. If you look at the statement of principles, you will find, as I said before, that the object of this 63½° rear air plane rule is to provide space for perflation of air between rows of buildings. In the examples given of Darjeeling, Simla or other hill stations, you have not got two rows of buildings

between which you want perflation of air, so you do not need to apply that rule there at all.

I entirely endorse all that has been said about the necessity of *enforcing* bye-laws. In the book of model rules and bye-laws which I prepared for the Bombay Government some time ago, I remember I started by saying you might have written at the top of each page, "It is no good having bye-laws if you do not enforce them." It is a great difficulty; one does not know what to recommend. There are in Bombay, and I hear there are in many other Provinces, municipalities who will stultify any bye-laws you may make by refusing to enforce them. I can only suggest that it may prove necessary for Government to decide to legislate, to the effect that in such cases the disposing of all matters connected with the enforcement of bye-laws should be left not to the municipality as a whole, but to either an executive officer or a small but very select committee.

There was a point raised by Major Beadon as regards set-backs. In Bombay the Improvement Trust acquired their estates and then laid down their set-back lines, so that they have to pay through the nose for land which ultimately goes into roads; and the municipality themselves are just now in a great difficulty because they realise that they have let themselves in for enormous expenditure under the present law for paying compensation for set-backs for roads outside the Improvement Trust estates. The whole question is now being considered by separate committees and, perhaps, we may have something more to say about that a year or two hence. For the present we only know that this is an insuperable difficulty which adds greatly to the expense of the Town Improvement scheme.

SECTION B.

First Session.

The Hon'ble Sir Pardey Lukis, K.C.S.I., K.H.S., I.M.S., Presiding.

(*a*) *Kala-Azar.*

The President :—We propose to make a slight change in the agenda this morning for the convenience of the delegates. We shall begin with kala-azar, after discussing which, we will take Dr. Bentley's paper on the reaction of mosquitoes to artificial light. Then we will adjourn to another part of the building where Major Christophers will give a practical demonstration, with reference to his synoptic arrangement of Indian anophelines. As regards kala-azar, before I ask the various gentlemen to introduce their papers, I wish to say that the reason why we have not been able to put before the Conference the report of the kala-azar committee, is that it was delayed in submission. I did not receive it till I came here at the beginning of this week and it has been impossible, therefore, to have it considered by the Scientific Advisory Board. Most of the members of the committee are here and will be able to speak on various matters. I have already mentioned to you Captain Patton's observation on dogs and you have a précis of Captain Mackie's work before you.

There is only one point in connection with this report which I desire to speak about, and that is as regards certain observations which have been made by Dr. Korke. Dr. Korke has examined a large number of smears from the bone-marrow and spleens of dogs, and in four cases he has found one or more isolated bodies resembling Leishmania in appearance. It is a little doubtful whether these bodies are really Leishmania and therefore I have advised Dr. Korke not to publish his observations as yet. We propose to continue the observations and also the work which he is doing in confirmation of Dr. Row's inoculation experiments. I only mention this now, in order that if Dr. Korke's observations are confirmed later on there may be no doubt as to the priority of the discovery.

Captain Mackie introduced his paper "Kala-azar in Assam,"* of which the following is a summary :—

The contribution is a précis of a progress report of work undertaken between the months of February and September 1913.

A study of the history and incidence of kala-azar from 1891 onwards shows that there has been a very slight increase during the last three or four years, though scarcely enough to confirm the belief of villagers that a distinct recrudescence has occurred during recent years. Of the cases observed, eighty-one per cent. were in the first fifteen years of life. The author advances the opinion that the main point of epidemiological interest in the disease is its dependence upon *close personal contact.*

Out of 433 examinations of the peripheral blood, the specific parasites were found in 11 per cent.; but excluding "doubtful" cases 21 per cent. showed Leishmania. The author is not inclined to believe that the significance of the parasite in the blood stream is as great

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as some believe. Experimental work on animals is being undertaken; the negative results from dissection of flies, mosquitoes, fleas, bed-bugs and other insects is referred to. The spleen and bone marrow of dogs from kala-azar villages have not shown any visible infection.

The author has tried various methods of treatment without success, though intestinal antiseptics are useful in reducing the fever and improving the general condition.

The work and investigation is still being carried on in different parts of Assam.

CAPTAIN MACKIE :—The paper which is before you in my name is a very short précis of the work which has been carried on by me under the Indian Research Fund during the last 8 months. I divided my report into three parts—epidemiological, clinical and experimental. Under the heading of epidemiological I have not been able to throw any light on the transmission of the disease. I was not able to find that caste or occupation had any influence or cause, or that there was any particular relationship between kala-azar and climatic conditions or meteorological conditions. As you have mentioned, Sir, there was a very interesting point about the age distribution which shows that kala-azar at present, in Assam at any rate, is a juvenile disease, because 80 per cent. of the cases were in people under 15 years of age. Whether that tendency to attack the young is due to any particular conditions of childhood it is difficult to say. It however coincides fairly accurately with the time since the big epidemic in 1906-07, so that it looks as if kala-azar were particularly prone to attack the juvenile population which had sprung up since the big epidemic. And therefore it may have something to do with the question of immunity. I have made some remarks here on the question of sexual intercourse, as last year you referred to it particularly as a question which needed to be considered. I am inclined to place no importance whatever on the relation of sexual intercourse to kala-azar. The next part of my report deals with clinical observation. I don't wish to say much on this part of the subject except just to lay stress on this question of irritability of the heart which has not, I think, received the attention which it might have done. I found that the heart beat was almost invariably quickened quite out of all proportion to the temperature. In this connection it is rather interesting to note that I saw a case in the hospital here which had been diagnosed by Colonel Rogers as a case of undoubted kala-azar. And there, as I pointed out to Major Walton, the heart beat was 148 although the temperature was about normal. Then under the head of experimental work I have a good many records, but unfortunately mostly of a negative character. I examined 433 specimens of the peripheral blood, and I found that Leishmania were present in about 20 per cent. My examination was nothing like as extended as that generally adopted by Colonel Donovan and Captain Patton in Madras, because for the most part they diagnose their cases by the examination of the peripheral blood, and therefore it is not strange that they record a very much larger proportion of positive results than those people who, for instance, adopt spleen puncture as a method of diagnosis. So that I don't think there is necessarily any very great difference in this respect between the Madras cases and the Assam cases, but I shall be glad to hear what Colonel Donovan and Captain Patton have to say about that. Spleen puncture has been carried out by me in nearly two hundred cases since I have been on this inquiry. I have never noticed any ill effects from this small operation at all. Then as to the question of the significance of the parasite in the peripheral blood. That is, I think, a very important and interesting question, because it has been assumed that because the parasite appears in the peripheral blood it is necessary that the disease must be transmitted through the peripheral blood. Of course, the probability is largely in favour of that hypothesis. But it does not absolutely make a suffi-

ciently sure foundation on which to rear a very large superstructure. I do not think that anybody has ever succeeded in inoculating any animal directly from the peripheral blood nor in cultivating Leishmania, even in cases where there have been a large number of parasites. Then with regard to my animal experiments. I have done 49 animal experiments altogether and I found for the most part that animals are very refractory and difficult to inoculate. There my experience coincides with those of other workers in Madras and elsewhere. I have recently also succeeded in inoculating dogs with kala-azar in Assam, by introducing human spleen material into the peritoneal cavity. Otherwise I found that the flying fox is a most susceptible animal, and as it is very high in the zoological scale and cheap, it may be a useful animal for future work. Then I have examined a large number of insects of different kinds. I have laid down fly paper in a large number of kala-azar houses, but the insect catch has been very disappointing--only a very few biting insects were obtained from any of the houses. Flagellates have been found in sandflies and have been identified as such by Professor Minchin, though their source and nature are obscure. I have also examined a good many intestinal worms as well as mosquitoes, fleas, and other insects, but I have found nothing at all in any of them. The question of the bed-bug is also very interesting, although the number of bed-bugs I have examined is not very large. Instead of taking a large number from stray sources, I confined myself to examining only those actually caught in the bedding of kala-azar patients, and from these a total of 469 bugs were obtained. These bugs in every case were brought to the laboratory, and they were dissected and examined in the fresh state and afterward stained, and in 209 of these the stomach contents were introduced into the tissue of a monkey, and of flying-foxes and dogs. I examined these animals a few days ago and so far I have not been able to get any positive results. Then this question of dogs which is a very important one: I have killed 93 dogs under the same favourable conditions. That is to say, I have always chosen dogs who have been in or about a kala-azar house or in the vicinity of kala-azar patients. I have subjected them to microscopic examination, and I have also inoculated the bone marrow of a number of these into animals, but these latter which were also examined a short time before I came, have also remained negative, so that the evidence in regard to dogs in Assam is also negative in the same way as the examination of bed-bugs. As I said before, I have succeeded in inoculating a dog, so it proves in Assam also the dog is not immune at any rate, even if it is not actively concerned. I have recently paid some attention to other possible sources of infection—and I have examined the fæces in a considerable number of cases, and also fish and so on, on the supposition that they might possibly be in some way connected with the question. But there again my observations have been largely negative. I have found bodies closely resembling Leishmania in the stools in two instances. But that may be a mere accident. All these experiments are going on in various parts of Assam at the present time.

Lieutenant-Colonel L. Rogers then introduced his paper on "The bearing of Assam tea-garden experience on the problem of the etiology of kala-azar,"* of which the following is a summary:—

Seventeen years ago the author pointed out that infection in kala-azar is essentially a house or site one. Since that time Dr. Dodds Price has carried out measures on these lines in tea gardens in the Nowgong district with uniform success.

Over two thousand cases have been followed up from first to last.

Segregation methods have been adopted. Out of infected lines only those households which were completely free from the disease

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were moved into new ones. No new coolies were admitted into the old lines, and vacated houses were destroyed.

The population concerned numbers about 8,000. In no single instance has kala-azar occurred in the new lines, and the disease has been completely stamped out of a number of gardens; this result cannot be attributed to a general decline of the disease in the district as a whole.

Control examples show that the disease continues indefinitely in infected lines in the absence of such segregation methods. The author reiterates the arguments incriminating the bed-bug as the probable carrier of infection. Water and diet can be absolutely excluded. The conclusion arrived at is that "the bed-bug theory best accounts for all the known facts."

Lieutenant-Colonel Rogers:—The paper I have laid before you to-day is an abstract of a fuller paper by Dr. Dodds Price and myself last year. I have been asked by Sir Pardey Lukis to bring it forward as it might be of some help in our discussion to-day. I wish, in the first place, to make it quite clear that any value this paper has is due to the work of Dr. Dodds Price. He has been over 20 years in the Nowgong district of Assam, and he has only been on leave for a few months on two or three occasions. He has had continuous charge there of kala-azar cases among the tea-garden coolies, and has been able to follow up over 2,000 cases from first to last. During over 20 years—that you will agree is a unique experience of the disease—Dr. Dodds Price has carried out most successfully the segregation methods which were worked out by me in conjunction with him, at the time of my original investigation in 1897. I published the results a few years after the first experiment carried out in the old Salara lines, Nowgong, where the infection was so great that out of 240 souls there were only 96 who had not got the infection in their houses. We moved out the healthy people, only taking those in whose houses no cases of kala-azar had occurred, and moved them into new lines. These new lines were filled up with freshly imported coolies to number some 500 people. They have been absolutely free from kala-azar for the last sixteen years. During the early portion of that time the coolies who were left behind in the old infected lines, which were only 400 yards from the new lines, were attacked, and the disease went on among them and carried off over 80 per cent. of these people. It further spread to a neighbouring line of 60 souls, and over 80 per cent. of these were carried off, and yet in the new lines, only 3 or 4 hundred yards away, the 500 people remained perfectly free. The disease has now died out of the old lines and that particular area is now free from kala-azar. Subsequent to that time these experiments have been carried out in 9 more cooly lines. In the full paper you will find the results tabulated. These lines contained a working population of 6,727 people (including children over 8,000 people). With the exception of one line, they were moved about 8 years ago, and still the whole of these lines are absolutely free from the disease. To give one example which is a typical one (I mention it because more accurate data are available with reference to it), namely, the Amluckie tea garden—there the disease was so severe that during two successive years it carried off more than a hundred per thousand of the population; the lines were then moved to a new place and those lines now contain nearly a thousand people, and they have been free from kala-azar for 11 years; the disease having been absolutely stamped out, those remaining in the old lines having gradually died off. Similar success has now been obtained in 10 different cooly lines. Next we want to know whether this dying out of the disease could have been due to the decrease of the epidemic in the district during those years. Here we have the important fact that only three years ago a severe outbreak on a tea-garden took place, and the disease was just as bad then as during the original epidemic, and the same measures were successful. So we have the fact that during 16 years

these measures have been uniformly successful over the whole of that period. The success, therefore, cannot be due to any dying out of the disease between 1897 and 1900 when it decreased so greatly. But we have still further and still more conclusive evidence, because there still remain two lines where these measures have not been carried out. The most interesting of these lines is the old Rangamatti tea garden one, and there we also have a new cooly line. Before I went to Assam, as far back as 1895, these old lines (only some 200 yards from the new ones) were infected. The new lines have now remained free ever since 1895—nearly 19 years, and yet during the whole of that period, in the old infected lines which have not been moved, the disease has still gone on year by year. We have only got detailed records since 1908, because the hospital was destroyed by fire that year. During the last five years we have had 63 deaths varying from 9 up to 14 in the year. And so we find that where the old infected lines have been left undisturbed the disease has gone on. In another garden, the Salona garden, we have had the same experience. There we tried other measures. The disease of 1897 was not very severe in those lines, so I suggested that instead of removing the whole of the lines which contained a very large population—over 1,500 people—we should move out the infected people and their households, and we did that and put them in the segregation lines. The result was that the death-rate which had been 74 and 75 in the two previous years at once fell, and came down to anything from 2 to 12. Then after a few years the disease began to increase again, and in 1904-05 I visited Assam and then we carried out further measures. In the first place, we built new lines in which newly imported coolies were placed. The new coolies did not then come into the old lines. Another very interesting experiment we carried out there was to test the bed-bug theory. To do this we selected one line, and Dr. Dodds Price set to work to try to destroy all the bugs in the infected houses during the hot weather, when the infection is at a minimum. This is a troublesome and expensive measure. He had to burn all their clothing, disinfect all their beds, fumigate their houses with sulphur, and this was repeated several times. During the next five years there was less than half the number of cases in the old lines, which were not treated by that method. So that as far as the evidence goes it seems to show that the measure may have had some good effect. Recently within the last few years there has been a recrudescence of the disease in those lines. But in this case it appears to be due to the fact that the new lines in which the newly imported coolies were put had become full up, and during recent years a number of newly imported coolies have been sent into the infected lines, and the disease has had a distinct recrudescence. Here again we have the fact that in this line for 20 years the disease has continued year by year, although in ten other gardens the disease has been completely stamped out by the measures adopted. So I think we have a very successful control with regard to this experiment. These facts from the personal observation of Dr. Dodds Price are unique, and we may safely accept them.

The question now is, what is the bearing of these facts on the theories of the infection of the disease. As I showed in my original report, the disease is either a house one or at any rate a site one. And the question is, how far the observations of Captain Patton on the development of the parasite in the bed-bug are sufficient, and how far they go towards proving this theory. Not very long ago in the second edition of my book on Fevers in the Tropics, I said that owing to the infection being found so rarely in the bed-bug it was a very doubtful question whether it was the carrier, but on considering this question further in the light of the above epidemiological facts I think I have modified my view. And I should like to quote here from my paper.

In the paper with Dodds Price in discussing this point we wrote as follows :—

'It has been objected that Patton has only succeeded in obtaining a very few such positive results in a large series of experiments. If we consider for a moment the epidemiological facts, this does not appear to us to be such a serious obstacle to the acceptance of this theory as might at first sight appear. It will be evident from the data in the first portion of this paper, that a very considerable proportion of persons may live for a number of years in the same cooly lines, or even, as often happened, in the same house as other persons infected with kala-azar, and yet for long escape infection. The further fact, that if people go on living long enough in such infected houses the great majority of them do eventually contract the disease, so that after a number of years almost the entire population of a set of huts may die of kala-azar, appears to show that the slowness of the infection is not due to lack of susceptibility to the disease. We know that in the same lines every soul is likely to contract malaria over and over again within the same period of time' (yet only a very minute percentage of the carrying species of mosquitoes may be found infected); 'we can also testify from personal experience that bed-bugs can be collected by the score from every cooly hut. It would appear from these facts that if even one bed-bug in a hundred was capable of carrying the infection of kala-azar, every person in an infected house would rapidly develop the disease. Moreover, the rarity and scantiness of the parasites in the peripheral blood will alone account for much of the difficulty in feeding experiments. It would be quite sufficient for bed-bugs only very rarely to become capable of conveying the infection under conditions (an exact knowledge of which is not yet available) to enable them to be efficient carriers of the disease.'

In short, the very fact that the parasite has only very rarely been found developed in the bed-bug is to my mind in favour of the theory rather than against it, because if they were infected more readily it would not explain the epidemiological facts—because all people would rapidly die out. However that may be, the fact remains that the segregation methods suggested by me in 1897 have proved eminently successful, and have stamped out the disease in a large portion of the population, and this saved the tea industry from very great losses. And it is particularly interesting to note that this method of stamping out kala-azar was worked out as the result of epidemiological studies at a time when the true nature of the disease was unknown. At any rate, the careful observation of the facts regarding kala-azar on the tea gardens are of the greatest practical importance; they must be taken into account and fully explained by any true theory of the mode of infection of the disease.

Captain McCombie Young :— My paper* deals with the problem of kala-azar in Assam from a public health aspect, and gives an account of the result of an investigation undertaken by the Assam Sanitary Department to determine the degree of prevalence of kala-azar in the Province and to decide what measures should be taken to deal with the disease.

Some figures are given in the report showing the age and sex incidence of the cases seen, the varieties of domestic animals found in infected houses, and the surroundings of such infected houses, etc. The figures are substantially the same as those given by Captain Mackie in his paper.

A map is included in the report which shows in a general way the present distribution of the disease in Assam.

At the time when the paper was written the survey was incomplete in certain areas which are coloured blue in the map.

Information is now available in regard to these areas and it appears that they are practically free from the disease.

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Two recommendations for dealing with the disease were put forward to the Assam Administration.

I. The allocation to infected areas of special travelling dispensaries under the control of the Sanitary Department, to watch the progress of the disease, to render medical aid to infected persons and to apply measures of segregation and removal where possible.

II. The introduction of the Epidemic Diseases Act to prevent migration from infected areas, as originally recommended by Lieutenant-Colonel Rogers. The first recommendation has been accepted, the second is now under consideration.

The investigation clears the way for further research work in regard to both kala-azar and malaria in Assam.

I have maps here which show the distribution of the disease in greater detail than could be given in the printed map. I shall be glad to show these maps to those interested.

DR. KORKE :—Unfortunately my paper is not before the Conference. Still I have to make a few remarks about certain facts in kala-azar I observed in Madras. As regards the epidemiological facts, I think kala-azar is a household infection and not a house infection.

In the second instance one gets kala-azar by contact, and I have also shown in the paper in 1912 that kala-azar has a tendency to travel by the sameness of the community. I made very extensive and searching observations and the details are recorded in my last paper 1912.

From the last year's observation, 1913, I endorse the views that I advanced in the year 1912.

As regards age, it appears that age is of little consequence in the infection of kala-azar in Madras, though I have rarely seen a case above the age of 60. All ages and sexes, though there are difficulties about their admission in the hospital, seem to be equally affected. Regarding the point brought in by Colonel Rogers as to the infection by sexual contact. I have studied that point in Madras and except in one or two cases where husband and wife were both infected, when one gave infection to the other, I have never seen a case where infection through sexual contact was of any importance. Then I may as well remark that in Madras kala-azar is restricted to an endemic area—called George Town. It has travelled very slowly for the last 10 years in the neighbouring districts of the city of Madras, and one point I may as well mention here is that almost all the houses in George Town have got wells, which does not appear to be the case in many other parts of the city of Madras. As regards clinical observation, almost all the cases are diagnosed by means of peripheral examination of the blood. Spleen puncture is hardly ever resorted to, as it is supposed to be particularly dangerous, at least in Madras hospitals. I think peripheral examination equally answers the purpose. I have seen two cases, very early cases of kala-azar, which came to me,—one began with the symptoms and signs of dysentery, and another a case of a European who was treated in the General Hospital for typhoid. They were cases that from a peripheral blood examination proved to be cases of kala-azar. In one case the dysentery was of a few days duration. The patient was entirely free from other disease before and he was being treated for dysentery only. There was no enlargement of the liver or spleen, and there was no temperature. In the case of typhoid too—it was rather an important case—there was an enlargement of the liver and spleen. It appears then that the onset of disease may begin with symptoms of dysentery and enteric, and in the early stages there may not be enlargement of liver or spleen at all, or in a word the disease may commence with initial intestinal disturbance.

Row has made observations that Leishmania Donovani is capable of producing a localised infection. A pocket is made usually in the

skin of the forehead, and substance from bone marrow or spleen is insinuated. After an incubation period of 50 to 70 days a nodule appears. The nodule seems to be freely moveable, hard and fibrous, in the beginning about the size of a pea—grows to the size of a small walnut in about a month's time, and finally disappears or is absorbed. When you scrape the nodule you find Leishmania.

I repeated his experiments with positive results. I got positive results in four cases and the incubation period ranged between 50 and 70 days. Row made a communication to you, Sir (Sir Charles Lukis) at the International Conference, and he says he has found that the absorption of nodules gave rise to the generalized infection. This observation was made simultaneously by me when I was sent to Bombay in January on special duty in Row's Laboratory; we inoculated two monkeys, and I made on the 1st of July the same observation which he found, I suppose on the same date or a little later on, I am not quite sure. But he had an opportunity of demonstrating his experiments to the public. So kala-azar is capable of producing a localised infection. I may as well throw in a suggestion here that if the insect theory is to be completely demonstrated, it is comparatively easy to introduce the infected contents of the bed-bug into a pocket of a *M. sinicus*, producing a localised nodule, and to see the presence of Leishmania there. As regards the peripheral cultures, I already noticed the point brought in by Captain Mackie about the cultivation of parasites from the peripheral blood. I failed to cultivate Leishmania, also failed to inoculate monkeys by the peripheral parasites. I may as well mention that I was doing cultures from the bone marrow and spleens, when Captain Patton was examing cultures from stray dogs in Madras. I made nearly 600 cultures and I obtained negative results. Finally, I have nothing more to say except to lay stress on the fact (that so far as my observations were made and they spread over cases collected from 1903 up till now on cases diagnosed by Colonel Donovan) that kala-azar is a household infection and has a tendency to spread by contact. In almost all cases when one could get a reliable history one got evidence of previous contact.

It is too early here to discuss the significance of a localized pathological lesion of Leishmania Donovani in a Macocus sinicus."

Dr. U. N. Bramachari said that the irritability of the heart so frequently observed by Captain Mackie was not noticed in his cases in Calcutta. As regards the examination of the peripheral blood, he stated that he could very rarely find the Leishman-Donovan bodies in it, though the method employed by him was a very special one. He took a few drops of blood and centrifuged it and took the layer of leucocytes at the top of the deposit and made a smear. In this way he could get fields containing very large number of leucocytes, but careful search did not reveal to him the presence of Leishmania in them. As regards the bed-bug theory, he pointed out that he had examined the stomach contents of a large number of bugs caught from the beds of patients suffering from kala-azar in the Campbell hospital, Calcutta, but he could never discover the presence of Leishman-Donovan bodies in them. Besides, he believed that the bed-bug theory could not explain the terrible epidemics that took place in Bengal in the fifties, namely, the Burdwan and the Jessore fever, which, according to the observations of Colonel Rogers, were epidemics of kala-azar, because he could not understand how suddenly the bed-bugs could be infected in several houses at the same time.

Dr. Bose :—In the voluminous literature upon the subject of kala-azar we seldom come across cases where the parasites have been discovered in the earlier stages of the disease and unless that is done the evidence is not conclusive. The mere fact of the presence of the parasite in the sample blood obtained from the splenic puncture of a patient suffering from enlargement of the viscus does not neces-

sarily prove that there was no Plasmodium malaria in the earlier stages of the disease, nor does it nullify the theory that Plasmodium malaria in certain stages may undergo still further metamorphosis. Now, I submit that there are cases of malaria which do not readily yield to quinine and there are cases of kala-azar which are benefited by the exhibition of quinine. Colonel Rogers, than whom no better worker in the field of tropical fevers has ever come to India, has said that in one case he found beneficial effects from the timely exhibition of quinine although that case was a confirmed case of kala-azar. Colonel Rogers said last year that kala-azar is indistinguishable in the early stage from the ordinary case of malaria and that he always found the malarial parasite accompanied by Leishmania Donovani. Segregation and isolation in a favourable site have proved efficacious in Dr. Price's cases. I would also beg leave to remind him that the same thing happens in cases of malaria, when these patients are removed from swampy ground to a dry place. There we get the same beneficial result.

THE PRESIDENT :—I just want to get at your meaning, Dr. Bose. Am I right in putting it in a nutshell that you wish to bring forward for consideration the point that possibly the Leishmania Donovani is a stage in the life-history of the malarial parasite ?

DR. BOSE :—That is my idea.

DR. BENTLEY :—I have followed the present discussion with very great interest, though for the last ten years I have not been able to take any active part in the investigation of kala-azar, I was before that in a position to study a very large number of cases ; not such a large number as Dr. Dodds Price has done, but very nearly—I think practically—about half that number. And those cases also occurred in epidemic form on several tea-gardens in the Darrang district of Assam. Darrang is on the north bank of the river, and Nowgong is on the south bank. In 1901 we first discovered that kala-azar was prevalent and was present in epidemic form on a large tea-garden line containing about 700 coolies. Very shortly after it was found to be present in another line about a quarter of a mile away. Subsequently we found about 25 cases in another garden—about three miles further on. On the big garden—the main garden—two lines were found to be infected. There were four other lines—but they were all at a little distance—a quarter to half a mile from the infected lines. There were these differences however. The two infected lines were on lower land which was of a more sandy nature than the non-infected sites and they were close alongside some uncleared virgin forest. The non-infected lines were surrounded by cultivated land and tea. There was also, I might mention, a difference in the water-supply, for whereas the two infected lines were supplied by wells which had been constructed many years previously of bad bricks, unsteined and cracked, which allowed the surface water after a heavy shower to run right into the well, in the healthy lines the water-supply was from wells which had been properly constructed and lined by cement.

Another point. In the infected lines there were very old coolies, and they had been allowed to have very much their own way, with the result that they kept cattle in the verandahs of nearly every house. They had also got their little gardens round the houses. In the healthy lines the cattle were not allowed to be in the verandahs of the houses. There were cattle-sheds and all cattle were stabled apart from the dwellings. When we realised that we were in for a serious epidemic, and knew it to be kala-azar, because after Leishman's and Donovan's discovery of the parasite I was also successful in finding the organism by spleen puncture in many cases, we adopted the suggestions for segregation that had been made by Colonel Rogers some years previously. But I may say we did not get the same results that have followed in Nowgong. We had two lines made at a distance of about half a mile

apart. All the coolies were taken away from the infected lines—and the sick coolies were separated from those who were well. The old lines were entirely abandoned, and their roofs were taken off and they were allowed to be exposed to the sun and rain. Meanwhile a certain number of cases began to occur in a healthy line half a mile away from the infected line. In most of these cases relationship could be traced between them and coolies in the infected lines. I did my best. I warned the manager that he was running a big risk and that he would get kala-azar all through this line unless he segregated the sick. But nothing was done. In 1904 I went on furlough to England. There were then 60 cases of the disease in the line. I came back after ten months and expected to find kala-azar sweeping through the line, because segregation measures were not being taken. I found instead 20 cases living, 20 cases dead, and 20 cases recovered. The disease has now practically died out, but there are still coolies living there in whose spleens I found the parasite 10 years ago. There is now no kala-azar on the first site which was abandoned. After two years the coolies were allowed to go back there. The only change that has occurred is that the water-supply has been looked after, and the virgin forest has been entirely removed.

These two instances show that in Tezpur the same results—a dying-out of kala-azar—have followed upon (1) careful segregation, and (2) complete neglect of the precaution. And this suggests that the disease has died out by natural causes rather than as the result of special measures.

Major McCarrison :— Capt. Mackie has referred to the fact that 67 per cent. of cases of kala-azar have rapid heart. In connection with this observation I should like to suggest to him the possibility that the rapidity of the heart's action in these cases might be due to hyperthyrosis. I wonder whether in the course of his observations he has noted the microscopical appearances of the thyroid gland in such cases. You will remember that Dr. Carlos Chagas describes one form of the disease which he has named " Parasite thyroiditis " as the " cardiac form," and he records the fact that rapidity of the heart's action is one of its most prominent features. It occurs to me that probably these cases may show some interesting thyroid changes.

Captain Patton :—I am sorry that I have no paper this year on kala-azar. I have made no original observations and I feel rather diffident in saying anything. I have, however, made a few points and I may just say a few words on them. In the first place with regard to examinations of the peripheral blood my experience has been entirely limited to Madras and I have never yet failed in finding a parasite except in one instance. I have on several occasions seen kala-azar patients from Calcutta and I have also found the parasite in the peripheral blood. The question regarding the dog and kala-azar in India is extremely important owing to the fact that it occurs in association with the same or similar disease along the Mediterranean littoral where there are dogs in contact with the patients. During my experiments on dogs a rather interesting phenomenon turned up. Two of my dogs that were inoculated with heavy spleen emulsions were kept along with some other dogs in an animal experiment room, and I thought the experiment was going to fail. However, it was soon found that these dogs were beginning to emaciate and in their blood I found *Piroplasma canis* and very shortly after that enormous numbers of kala-azar parasites. Now this has occurred three times, not only in dogs but also in the case of a jackal. The jackal is, as you know, immune to *Piroplasma canis*, and this jackal was kept in the same place, and it is probable that the three experimental dogs had contracted piroplasma from ticks which had come off from some other dogs that were in the room. The result was that these three dogs died

of kala-azar complicated with *Piroplasma canis*, and it seems to me that there is some curious connection between the two diseases. If dogs which have been previously infected with kala-azar develop *Piroplasma canis*, the kala-azar parasites multiply and appear in enormous numbers in the peripheral blood. Whether it would have occurred if they did not develop *Piroplasma canis* I am at present unable to say. While this experiment was going on the dogs were swarming with fleas, and a curious incident happened, which I think I may mention as it is rather interesting. A friend—I won't mention names—had a dog which was ill, and this dog was in the habit of coming into the experimental room, and of course there is no doubt that fleas passed from the experimental dogs to it and it was swarming with fleas at the time. Films were taken of the peripheral blood of this dog by two assistants of mine rather late in the evening, and the friend to whom this dog belonged came to me afterwards and said he had just been told that his dog had kala-azar. You can imagine my state of mind when I heard that his dog had developed kala-azar. It made me at once think that the flea was the most probable transmitter. I went down to the laboratory and had a look at the slide and found any number of kala-azar parasites. The same evening we isolated this dog and noted that we all had fleas on us and as a result spent a very uncomfortable night. Next morning I took a number of films from the dog and also examined the films taken the night before. And I at once solved the mystery. What had happened was that one of the experimental dogs which I had inoculated had died that very afternoon, and the assistants in their enthusiasm had taken something like two hundred slides of the blood, and they had left two of the slides unstained in one of the slide boxes. In the hurry when my friend brought his dog round they took out two of these slides and took this dog's peripheral blood on the same slide and that was why kala-azar parasites were found. I mention it to you because it is the sort of thing that may happen in any laboratory.

I had an excellent opportunity at that time of making a very careful examination of the fleas from this dog, but I must say that I could find no evidence of the development of the parasite. But I was struck by the fact that the fleas passed out unchanged parasites 8 hours after ingesting them. It seems to me that it is quite possible that the flea may transmit the canine form of kala-azar by actually passing out the parasite on to the skin of the animal in an unchanged state, and what I saw from these fleas in Madras seems to support that view.

Dr. Korke refers to inoculating the contents of bed-bugs into animals to see if he could produce a local sore. That is easier said than done, because in the first place we are not quite sure yet when we should inoculate the contents of a bug which has been fed on a case of kala-azar. We want to find that out. I would, therefore, strongly deprecate such an experiment.

With regard to insect experiments in general, I think there is no more hopeless piece of work than to feed say 100 bugs or fleas on a patient and then to start dissecting them. It is physically impossible for one man to do that. It means that one dissects five or six insects very thoroughly, and the result is that the rest remain over and pass on to a different period, and one loses the value of the experiment. So that I think the investigation of kala-azar will never be solved by one man. It would accelerate the progress of this investigation if we had two or three men trained in insect work, that is to say, men who absolutely know everything about the insects they are to deal with. I have listened with great interest to what Captain Hodgson told us the other day with regard to the fact that mosquitoes always remained at the temperature of the wet bulb thermometer. I have all along felt that there is some factor connected with the transmission of kala-azar which

is not known yet, and I feel that nothing will be found out unless we can discover that factor. It is possible Captain Hodgson's observations supply this factor.

SIR PARDEY LUKIS :—There is one point I should like to mention in connection with what Captain Patton has just said, namely, that in the report of the Kala-Azar Committee I find it noted that in the four slides in which Dr. Korke found these suspicious Leishmania-like bodies, he also found large numbers of Piroplasma canis; this is rather an interesting point.

LIEUT.-COLONEL DONOVAN :—I might make a few remarks about kala-azar occurring in children. From Captain Mackie's paper he has been able to make out that a large percentage of children suffer from kala-azar. In Madras we do not possess very reliable statistics on the point, but I should say that, as a rule, children suffering from the disease predominate in Madras also. It is not the habit among the inhabitants of Madras to bring their children readily to hospital for treatment. And in such cases they allow the disease to go untreated and let the children die. Very little stress is laid on infantile mortality in India. On further investigation it will probably be found that infantile kala-azar predominates very much more than adult kala-azar. As to the irritability of the heart: I have not noticed it so much, but now that one's attention has been drawn to it by Captain Mackie we may be able to go more thoroughly into it. But from my recollection of the kala-azar cases I would not say that irritability or frequency of the heart was a very marked feature. I can say definitely that the thyroid was never affected. After Chagas's mention of thyroid involvement, I especially looked out for any abnormality as far as this gland was concerned, but with negative result. As to Leishmaniæ in the peripheral blood: Captain Patton has told you of the ease with which he finds it. If the doubters would like a demonstration, I am sure that the Madras workers here would be able to show it to them in the precincts of this building, as I hear that Major Sprawson has a case in the hospital here. I am sure the patient would not object as merely a drop of blood is required from his finger tip. There is another thing I would like to draw attention to, Colonel Rogers' re-iteration of the cohabitation with women, because the papers in Europe and America have laid great stress upon cohabitation as a cause. Of course owing to their ignorance they are acting upon Colonel Rogers' views. Anything that comes from him carries great weight and I see in most text-books on kala-azar that great stress is laid on cohabitation. So I would like to ask Colonel Rogers how many cases he has on record in which European planters who have cohabited with native women are actually suffering from the disease.

THE PRESIDENT :—It has already been explained that by cohabitation we do not mean sexual cohabitation, but contact of all sorts—continuous house infection.

COLONEL DONOVAN (*continuing*) :—As to Dr. Korke's remarks, I may say that Dr. Korke worked in a room in my laboratory. I have seen most of his work and I can confirm what he says about the nodule and the subsequent general infection. His finding of organisms simulating Leishmaniæ should be placed on record.

MAJOR CHRISTOPHERS :—I should like to ask Captain Mackie and Colonel Donovan whether they have paid special attention to trying to demonstrate free trypanosomes in the blood of kala-azar patients?

On the analogy of Trypanosoma cruzii, where there are free trypanosomes in the blood associated with Leishmania-like bodies in the organs, one might expect to find trypanosomes in very small numbers in kala-azar.

SIR PARDEY LUKIS :—Gentlemen, before asking the authors of the papers to reply, there are two points that have not been mentioned

as regards certain new methods of diagnosis which I would like to bring to the notice of the Conference.

(1) The first is that suggested by Cochrane in China, who following on the method adopted in sleeping sickness, suggests as a method of diagnosis that you should either remove or puncture the post-cervical or inguinal lymphatic gland, and he states that by removal in 20 cases he obtained 95 per cent. of positive results and 31 per cent. in 13 cases of puncture. On the other hand, Hill of Pekin does not confirm Cochrane's results. He draws attention to a new sign, namely, that when the blood of a kala-azar patient is mixed with a special diluent which he uses for leucocyte counts, instead of the red cells disappearing as they do in all other diseases, they run together in big clumps, which can be broken up only by long and vigorous shaking. I should like to know whether any observers in India have tested these methods. If not, I trust that they will do so and report to us the result of their observations. Full information on the subject will be found in the *Lancet* of August 9th of last year and in the Journal of the London School of Tropical Medicine for December 13th.

CAPTAIN MACKIE :—To reply, Sir, first of all to your two points. First as to auto-agglutination of the blood, I have done a good many blood examinations in the course of my investigations and I have not witnessed this phenomenon which has been spoken of by Cochrane. In cases of sleeping sickness and other trypanosome diseases it is a quite common one, but I have not noticed it in kala-azar.

As to gland puncture, I think most people will agree that enlargement of the lymphatic glands is very unusual in kala-azar. In my clinical observations in 360 cases I have not noticed lymphatic enlargement except in one or two instances, and then only to a very small degree.

As to Major Christophers' reference to the possibility of there being trypanosomes in the blood, that is a very important question and one to which I have paid a certain amount of attention. I have examined a very large number of cases in the fresh state by ordinary methods, and also by the dark ground illumination method which is best calculated to bring out movements in the blood, and I have never seen anything to suggest the presence of trypanosomes in the blood nor even those occurring in culture forms which Leishman has described as being a split-off in a manner suggesting microgametes.

As to the possibility of a connection between goitre and kala-azar I may say that I have always made a point of noting the enlargement of the thyroid gland and its association with kala-azar, but I have not been able to find any relationship at all between the two diseases, and indeed in the majority of cases of kala-azar there is no enlargement of the thyroid gland at all. In my malarial examination of school children I have always taken a census of thyroid enlargement. As far as I remember now, in about 25 or 30 per cent. of the cases there has been a slight fullness of the gland, and the enlargement of the gland has been marked in about 7 or 8 per cent. of the children.

In Colonel Rogers' interesting paper there are one or two things which I should like to comment on. He has already touched upon the question of the possible relationship between the subsidence of the disease in the tea gardens and the subsidence of the disease in the whole district of Nowgong. I think I would like to emphasize that point rather, because all his figures go to show that there has been a remarkable coincidence both in the subsidence of the disease in the gardens and outside the gardens, and, as he says, during the last 3 or 4 years there has been a recurrence of the disease in the gardens, so in the districts there has been a more or less similar recurrence. I will send round a paper showing the mortality in the last 20 years from which you will see that the curve is a very sharp one. During 1906-07 while

Colonel Rogers was working in Assam, during the height of the epidemic, the mortality for those two years was 11,100 and 11,800. After he left the disease on the tea estates subsided very rapidly. But the disease in the districts generally also subsided very rapidly, so that with all due respect to his valuable opinions and to the work which Dr. Price and he have done on these gardens, I should like to emphasize that there may possibly be some relationship which we do not yet know between the subsidence of the disease there and in other parts of the district.

But when he comes to sum up in favour of the bug theory, and that these observations tend to prove the bug theory, I am not altogether at one with him. In the first place, there is no argument which Colonel Rogers has brought forward in favour of the bug theory which is not equally or still more applicable to the theory of close personal contact. All these measures which have been taken would have been as equally efficacious against a disease transmitted by close personal contact as against one transmitted by bugs. I quite agree with him that the starting point of an epidemic in a village is almost always due to the arrival there of an infected person. But that might be advanced in favour of the theory that I suggested equally with the bug theory. Then the measures which were adopted to stamp out the disease are not suitable only to the stamping out of the disease caused by bugs. The measures of Dr. Price which were so admirably successful, would be I think equally efficacious in many other diseases. Even in tuberculosis, if you separate the sick people from the healthy, and put them in new lines and under more hygienic conditions, there would be a marked difference between the people who have been thus removed and those who have remained in their old surroundings. So that the mere fact that there was a marked difference is only that comparable to other diseases which are not transmitted by insects at all. Then as to the question of house infection as against personal infection or household infection—I have never yet been able to get any undoubted proof that the house itself, as apart from the people in it, had any special infectivity. I think that the only way to prove that, would be to find a house which had been recently inhabited by patients who suffered from kala-azar, and then after the house had been empty for some time to allow it be occupied by a fresh lot of healthy people, and then to see if infection ever followed.

Then as regards rarity of peripheral Leishmania, I don't think it is a sound argument by analogy in any case. Because, on the one hand, Captain Patton had the extraordinary good fortune of having an animal in which there were, I believe, as many as a thousand Leishmaniæ on a single slide, and he did a large number of dissections and as far as I remember he was not able to get any development at the wide and varying range of temperature to which he subjected them. There was a case in which you had more parasites in the peripheral blood than you get say in cases of sleeping sickness. On the other hand, to take that example of sleeping sickness with which I am familiar, even in some cases where the trypanosomes were entirely absent from the blood for a daily examination for more than a year, the specific vector of the disease, the tsetse fly, was found to become infected to the extent of 10 per cent.

So that the absence of parasites, much less their rarity, is not alone enough to account for the difficulty of infection provided the insect is the true vector and not a subsidiary one. I do not wish to appear as an opponent of the bug theory at all, but I might merely say that in my opinion it has been rather overrated and rather more built on it than its foundations justify. I think that a great deal of further work should be done on the subject, and I think it is quite possible that some attention might profitably be paid to other possible sources of dissemination.

COLONEL ROGERS :—Many interesting points have been raised but I can only refer to a few. I think Captain Mackie brought forward an interesting point regarding the rapid pulse on kala-azar, if it is not due to goitre, which is so common in Nowgong, as I found also in my time. He has also brought forward a large number of facts which though they are mainly negative still are all important. It is only by a process of exclusion that we shall arrive at the truth in this matter, and I hope Captain Mackie will not be discouraged by obtaining a number of negative results, and that next year he will come forward with something much more positive.

Captain McCombie Young's paper is of very great interest to me, especially as showing that the disease has made very little progress in Assam since the time of my investigation in 1896-97. I was able to prophesy that it would not spread very much east of Nowgong and as a matter of fact it has spread very little. Now that we have a careful and accurate map of the prevalence of the disease in Assam we know exactly where the danger zones are, and we are now in a much better position to deal with it. And the fact that we have this accurate map will enable us from our observations of the different occurrences to tell what measures are likely to be effective. I hope it may be possible to carry out the measures which I originally suggested and with which Captain Young has agreed.

Dr. Korke says he has never met with cases in which the husband and wife have both been infected with kala-azar. Well if he went to Assam he would have no difficulty in finding scores of such cases, and I have also met with them in Calcutta. Colonel Donovan says that among the Eurasian population who come into hospital most are children. Kala-azar is also common in Eurasian children in Calcutta, but less so among Indians, because Indian children do not often come into hospital.

As Dr. K. C. Bose has pointed out, there is great difficulty in the clinical differentiation of malaria and kala-azar. I quite agree with him that in a single observation of a patient it is often impossible to be quite certain whether a patient is a case of malaria or a case of kala-azar, without a blood examination or spleen puncture, and so from the clinical point of view it might be quite impossible in many cases to differentiate. But now that we have these scientific methods it is possible to do so by spleen puncture or blood counts in every case.

Only yesterday I was looking for spleen cases in the hospital and Major Walton showed me two cases. I saw the first case and doubted whether that was kala-azar. On the other side of the ward I looked at a boy of 7. At a first glance I was absolutely certain that it was a typical case of kala-azar. He had enlarged liver as well as enlarged spleen. Owing to the size of the liver, I came to the conclusion that that case must have been going on for at least a year. And true enough, on inquiry it turned out to be so. I did spleen puncture and found the parasite quite readily. (The boy came from a neighbouring district where I believe so far no case of kala-azar has been found.) Major Walton will no doubt now follow up his observation and next year we shall have much more definite information with regard to the prevalence of kala-azar in this part of the United Provinces. It is only with a large hospital and skilled workers that we can make any progress in this direction.

Dr. Bentley referred to the bad water-supply in two lines where kala-azar was prevalent. There again, as I mentioned in our joint paper, Dr. Dodds Price shows that in a number of cases the wells were not constructed until some time after the removal of the lines, so for long the people were drinking the same water as the infected people, yet in no single case did kala-azar occur in the new lines. We may also safely exclude the diet factor for similar reasons, for people

living in the new lines were having the same diet as those living in the old lines.

Then Captain Patton and several observers have succeeded in finding the parasite in the peripheral blood. And there is no doubt that it can be found in the peripheral blood if a long enough search is made. But unfortunately those of us who have not so much leisure as whole-time research workers, like Captain Patton, cannot use that method with very much success. We had several such workers who had great difficulty with this method in Calcutta. Personally, I think that with proper precaution there is very little danger with spleen puncture, and I frequently do them in Calcutta myself.

The question of infection through the flea has also been raised. I do not completely exclude the flea—it may be the carrier as well as or even instead of the bug—I exclude mosquitoes and flying insects. The flea is well worth studying further. I have not yet tested this method of red corpuscle agglutination, which is one of the points I hope to take up. Captain Mackie—if I understood him rightly—refers to the falling off in kala-azar on tea gardens and suggests that it is due to the dying out of the disease in Nowgong. Well, I was careful to point out that these measures were carried out, the last only $2\frac{1}{2}$ years ago, others 16, others 8, and others 10 years ago—and they have been equally effective throughout. With regard to personal contact and the question of cohabitation, I was very careful to point out that this cohabitation simply meant personal contact. It is not sexual but personal contact with women who were actually suffering from the disease and came to the bungalow to sleep at night. And Dr. Dodds Price has given me cases of some six European planters who contracted the disease, and every single one of them was living with a native woman who had had the disease.

I do not see much difference between household infection and house infection—in each it is a matter of personal contact. I cannot see that there is any great difference in that or that it is of any great importance. I quite agree with Captain Patton and Captain Mackie that an enormous amount of more work is required and what we really want is laboratories where a number of workers can work away steadily and I hope that before long we shall have that in Calcutta, and that then we may make further progress in the etiology, and also, I hope, in the treatment of kala-azar.

Captain McCombie Young said :—I wish to thank Colonel Rogers for giving the weight of his support to my recommendations as the question how to deal with the disease from a practical point of view is of great importance to Assam, and his approval will strengthen our hands in the preventive measures we are undertaking on these lines.

(*b*) *Mosquitoes.*

Dr. Bentley in introducing his paper "Experiments to determine the reaction of mosquitoes to artificial light,"* said :—This short paper just records the results of a few experiments that have been undertaken in order to test the reaction of mosquitoes to artificial light. As a matter of fact, last year Mr. Howlett told us we know very little about mosquitoes. We only know their classification, etc. We do not know what actuates them.

As the short note tells you, I just experimented with light and I found that it is really startling in its results. Mosquitoes when kept in absolute darkness stay still and quiet, but as soon as there is the least twinkle of artificial light they make off straight away for it. It does not appear that they make for it absolutely—that they want to go right into very bright light, but they go within the neighbourhood of it. I think it is red rays that attract them because I find they

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prefer to stay on a dark red cloth and in a room with red glass windows—they will stay upon these.

There is a practical point in regard to this paper that I should like to emphasise. Now that we know that mosquitoes are attracted by artificial light, I think it is necessary to encourage people to make use of screening wherever possible, because the houses of Europeans are usually well supplied with lights and that may account for the fact that in districts like Hardwar, and in places such as those we saw yesterday, Europeans living in infected areas are almost certain to contract infection and suffer very frequently from malaria.

MAJOR CHRISTOPHERS :—Sometime ago I did some experiments with light, and like Dr. Bentley I was startled at the extraordinary quickness with which mosquitoes immediately got up and flew towards the light. I had a long tunnel of mosquito net, and in the darkness I situated myself at one end and had an assistant to show a light at various distances. In the darkness not a sound of mosquitoes was to be heard, but the moment a light was exhibited—it might be 50 or 100 yards away—all the anopheles had come up to the near end of the panel and were humming as they flew about. At the same time I did some experiments on sound. If an anopheles desires to reach a native bazar there are two things which would obviously help it—one is light and the other is the sounds which issue from the bazar. But anophelines paid no attention to sound. Talking, beating of tom-toms, etc., caused no excitement among the anophelines.

SIR PARDEY LUKIS :—Well, in view of Howlett's experiments I am afraid, Major Christophers, that yours were not musical sounds.

MAJOR GRAHAM :—I beg to associate myself with Dr. Bentley's remarks in regard to the power which light has in attracting mosquitoes. I think we are all more or less familiar with the fact that on moonlight nights not only mosquitoes but other insects seem to be very conspicuous by their absence in houses where they have been very prevalent. I think they are supposed to fly high on these occasions. The observation is quite a common one. The point which Dr. Bentley laid stress upon, that this ought to be used as an argument for screening houses is of great practical importance. We had an illustration yesterday at Hardwar. We saw there at a place called Bhimgoda the bungalow of the Executive Engineer on the large canal works. The bungalow which is going to be his permanent residence for the next 3 or 4 years is situated in a well-known hyper-endemic and malarially dangerous area. In spite of this the bungalow had absolutely no screens. This constituted a danger for his wife, himself, his children, his junior engineers and their families. I should like this Conference to pass some resolution compelling the irrigation, engineering, or any other department whose European or other employés are working in a known hyper-endemic area, to screen their houses by wire screening, not the screening of inside verandah windows, but a complete screening of the outside verandahs, so that life inside the screened area will be habitable in the rains.

COLONEL ROGERS :—There is a very interesting point with regard to moonlight. Some 80 years ago there were some very interesting observations made by a Dr. Balfour in India, as to the relationship of the incidence of malarial fever and the phases of the moon, and he gave very definite figures showing there was a relationship between habits. This may now possibly be explained by the effect of light on the anopheles.

DR. BENTLEY :—I think this point that we have raised with regard to screening is of very great importance indeed, and until Government takes action we shall find very great difficulty in getting even educated people in this country to do what has been done in America and other countries for many years. I may state that since the inves-

tigation of malaria and blackwater fevers in the Duars it has been carried out very considerably there. I think this question of light attraction of mosquitoes is a further argument for pressing the matter upon the authorities.

SIR PARDEY LUKIS :—Before we adjourn to another place, gentlemen, to see Major Christophers' demonstrations, there are just a few points that I wish to bring to your notice. I think you will all agree that this has been the most interesting discussion on both malaria and kala-azar that we have had in any of the three Conferences. It has demonstrated very clearly the importance both of research and of careful malarial surveys. It has shown moreover the utter impossibility of having one definite anti-malarial policy for the whole of India, and the necessity for adjusting our methods to local conditions.

Many of you who have attended the former Conferences may remember that three years ago some of the delegates laid great stress on the desirability of importing from Barbadoes the little fish called "*millions,*" and we were told that if we imported these fish and put them into all the rice-fields and all the tanks, in a very short time malaria would disappear, and India would be a very healthy country. This recommendation was based on the supposition that *millions* had freed Barbadoes from malaria. I have just been reading an interesting address given by Watson in November last before the Society of Tropical Medicine and Hygiene. One of the places he went to was Barbadoes, about which he says :—

'Here I confined myself simply to ascertaining whether the absence of malaria was due to the presence of *millions* or the absence of breeding places suitable for anopheles. In my opinion the absence of breeding places is the reason for the absence of malaria. The coral lime-stone absorbs water so freely that except in thunder-storms even the river beds are dry. I show you a photograph of one of the largest which is quite dry. It is well, people should know the truth about Barbadoes. *Millions* are useful—but they are not the cause of Barbadoes' freedom from malaria.'

In the discussion that followed Dr. Low who is, as you all know, a great authority on the subject, made the following remark :—

'I quite agree with Dr. Watson that the Barbadoes' *millions* were not the cause, and desire in passing to draw attention to the ease with which mis-statements of this kind find their way into the literature.'

I bring these remarks to your notice, gentlemen, as a vindication of the caution exhibited by the Indian Research Fund in not adopting the suggestion that we should import shiploads of *millions.*

I must also mention a letter which I have recently received from Major James, and I will read you one paragraph which may be of interest to those of you who are working in malaria.

He says :—'I am very sorry indeed not to be able to carry on the work here. My illness came just at a time when the mosquito problem was most interesting, for there was heavy rain daily, and the country was flooded. We found that in our experimental area we could still control stegomyia mosquitoes, as before, but various culicines—especially *Culex microannulatus* and *Leucomyia gelida* which breed in swamps and fly far, had everywhere become immensely prevalent ; and we had begun to study their habits in detail with a view to ascertain what could be done against them. In work of that kind there is a big field of study that might lead perhaps to finding a method of attack better than anti-larval measures—or that could be used when such measures are inapplicable.'

Lastly, I wish to allude to a point touched on in my introductory address. You may remember that I mentioned our desire for more information as regards the influence of wet cultivation. Since I made that remark Major Kenrick has drawn my atten-

tion to a recent report from the Central Provinces which I had not seen, and in that report he brings out the fact that ordinary rice cultivation does not appear to be harmful except when the crop is cultivated in the neighbourhood of forests, and where sluggish streams and jungles exist on the borders of such cultivation. In these conditions malaria-conveying mosquitoes appear to breed all the year round in shady streams and nullahs. It is doubtful whether open cuts are dangerous or whether actual rice cultivation is harmful apart from this condition of shady streams. This is in accord with the observation of Major Christophers in the Andamans. He found that rice cultivation did no harm in these islands, and I note in Malcolm Watson's lecture that in British Guiana he found very much the same condition of things. Speaking of Port Mourant where they have extensive rice cultivation, he says : 'I found not only drains and canals receiving no attention other than was necessary for the ordinary estate work and no oiling of the edges, but the whole population settled on the edges of over 3,000 acres of rice swamps. No anopheles were found in these drains or swamps.' These observations have a very important bearing on the subject of the influence of wet cultivation from the point of view of malariology.

MAJOR CHRISTOPHERS, I.M.S., then introduced his paper, "A Synoptic Arrangement of Indian anophelines with reference to teaching requirements,"* and showed a very interesting collection of Indian anophelines arranged according to a new plan. He referred to the present difficulties in regard to generic nomenclature of anopheles and suggested that the Conference should frame some uniform plan of procedure in this respect so far, at any rate, as workers in India were concerned. He himself was inclined to follow the lead of the British Museum authorities and include all anophelines under the genus *Anopheles Meigen*.

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SECTION A.

Second Session.

The Hon'ble Sir Pardey Lukis, K.C.S.I., K.H.S., I.M.S., Presiding.

(a) *Bacteriology of water.*

The President :—Before we consider Dr. Hirst's paper on the bacteriology of the Colombo town and well water, I will call upon Major Clemesha to make a statement on certain recent observations he has made as regards the conditions influencing the life of bacilli in river water.

Major Clemesha :—To commence with I should just like to say that this research is not yet complete and, therefore, no paper has been written on it for the Conference. However, a short interim statement, to accentuate the main points worked at, may be made. A problem which has puzzled sanitarians for many years relates to the fate of enteric organisms when they get into water. There is no doubt that occasionally water is the source through which enteric is spread, for serious epidemics have occurred, such as those of Lincoln, Maidstone, etc.; in these instances there is no doubt whatever that water is the incriminating agent: and secondly, mussels, cockles, and molluscs generally, are a very common source of spreading enteric at the present day. There is, I take it, no doubt whatever that these molluscs must derive their enteric organisms from the water in which they live. In fact, molluscs that are kept a long way from sewage pollution contain no enteric organisms, whereas those that come from infected water do. The other side of the picture is that some of the best bacteriologists have been diligently hunting for enteric bacteria in water for the last 25 years, and the number of successful observations can be numbered on the fingers of one hand. Occasionally now-a-days after years of work some of them succeed in isolating an organism which, as far as anyone can say, is the *Bacillus typhosus*. Nobody in this country, as far as I know, has ever succeeded in isolating it except Professor Haukin some years ago. All sanitarians who have worked on the subject are perfectly aware that it is practically hopeless to look for enteric organisms in an ordinary water sample, and I do not think that it is ever done in laboratories in this country. From a careful study of water inoculated with enteric certain facts have, however, been ascertained. In the first place, if laboratory cultures of enteric bacteria are put into water and allowed to remain, they very rapidly die out. There is no necessity to say more than this. The work of Houston on the subject is absolutely convincing and a great deal of other work has been done which confirms this. Another point which has been investigated in my laboratory very carefully indeed deals with the influence of the temperature of the water which has been inoculated with enteric organisms. It is pretty generally known that in water at a very few degrees above freezing point enteric organisms will live for very many months. With water inoculated with enteric and put into the incubator at 37 degrees the enteric bacteria died off with extreme rapidity. Experiments of this kind are not of very great value because pure cultures never exist in nature, so these results do not further the knowledge of the problem very materially.

Secondly, in my laboratory we experimented with mixtures of coliform and enteric organisms, and as a result we found that very much the same thing occurs. Here I should like to say that enteric organisms differ very slightly indeed from the normal fæcal bacteria in their behaviour in water. That is to say, if Houston's experiments were to be repeated using ordinary fæcal bacilli, the results would be almost identical, the bacteria falling off very rapidly, a few of them remaining for a considerable length of time. A mixture of enteric and fæcal organisms behave in very much the same way: that is if the bottles are stood upon ice and kept at a few degrees above 0°C. both the enteric and the coli bacteria will remain for a considerable length of time, and it is very difficult to show that the enteric bacteria decrease more rapidly than the coliform organisms. At high temperatures both seem to decrease at about the same rate. Now these experiments leave us, as I said, in very much the same state as we were at the beginning. Some experiments performed by Horrocks are extremely interesting. He found that as long as you keep a culture of enteric pure it will live in water or urine for a considerable length of time, but if you add a few coli, enteric bacteria very rapidly die out. In his case he does not state the temperature at which these experiments were carried out. He says the experiments were carried out at the room temperature at Millbank in London, so that it will be considerably under what it is in this country. However, he shows that wherever coli bacilli begin to multiply there Eberth's bacilli begin to disappear with very great rapidity. This has been entirely confirmed by work in my laboratory and we have hit on rather an ingenious way of demonstrating it. If 20 tubes of broth are inoculated with millions of enteric organisms and a very few coli—one, five, 10 or 100, any number you like—are put in each of these various tubes in increasing quantities, and if these tubes are put in an incubator, as a general rule within 18 hours practically all the enteric organisms will have disappeared. This is in some way due to the mutiplication of the coliform organisms which are so inimical to the life of the enteric bacteria. Now this is a very important point, for it shows that all methods of looking for enteric organisms which make use of a broth for the first step are absolutely useless. In the case of all usual natural mixtures one is trying to isolate a few enteric organisms that are mixed with a very large number of coliform bacteria. If you use a broth for the first step you are certain to fail. The only method which offers a reasonable chance of success is the direct method; to filter out the bacteria and plate them on a solid medium. MacConkie in his early papers on water-works used a glucose broth with the idea of increasing the paratyphoid and typhoid growth in the enrichment method. We now know this to be impossible.

The next series of experiments which were carried out in my laboratory show that enteric organisms are, as a matter of fact, very much more susceptible to the action of sunlight than are ordinary fæcal bacteria. Fæcal bacteria as everybody knows, are susceptible. They rapidly die out when exposed to the rays of the sun. Enteric bacteria in water contaminated with fæces exposed to the action of the sun will all die out within the first hour of exposure. This statement I make with a certain amount of reserve, because we have not yet worked with anything else but laboratory cultures. Presumably the action of the rays of the sun is one of the many factors which act in destroying these delicate organisms when by any chance they get into water. The experiments are still going on.

Dr. Hirst then introduced his paper on "The bacteriology of the Colombo town and well water."* The following is a summary:—

The chief object of the paper is to give an account of an attempt made at the Colombo Municipal Laboratory during the latter half of

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1912 and 1913 to develop methods for the bacteriological examination of water suited to the local conditions. A consideration of the pioneer work of Clemesha in India, and of other workers in America and elsewhere, shows clearly that no method for the detection and estimation of fæcal pollution of water is universally applicable to all conditions. The bacterial flora of the intestinal canal of man and animal differs materially in different localities. Clemesha has brought forward evidence to show that there is a decided seasonal variation in the lactose fermenting bacilli found in the fæces of man and domestic animals in India. It seems probable that some organisms, for example the *Bacillus enteriditis sporogenes*, may have a definite geographical distribution in the fæces of man. At the commencement of the work on the bacteriology of the Colombo water-supply, the methods customary in England, and based on those developed by Houston, were applied. Later lactose was substituted for glucose in the bile salt broth, used in the presumptive coli test, owing to the large number of glucose fermenting micro-organisms frequently found in stored waters. After a few months' work with the modified method on the old lines, and a careful study of Clemesha's work in India, as recorded in his writings, a trial was given to his methods, using, however, somewhat different culture media from those recommended. As the result of experiments the author is of opinion that the technique devised by Clemesha and his colleagues is effective for the isolation of vigorous lactose fermenting organisms in something like their original proportions in water. The weak point of the method lies in the inadequacy of the tests hitherto devised for routine work to differentiate certain of the species, and the difficulty of assigning a definite place in a scale of susceptibility to the influence of self-purification, to the various organisms isolated.

The study of the characters of 250 lactose fermenters isolated from 25 fresh human fæces in Colombo shows that the *B. coli communis* is the predominant organism at all times of the year. *B. coli communis* is also the commonest organism found in recently polluted waters in Colombo. In the middle stage of self-purification group 3 organisms and *B. lactis cerogenes* predominate; at the end of the purification process, a resistant variety of *B. coli communis* is found in small numbers on the surface, while at a depth, an organism called, for the sake of convenience, the bacillus C, alone remains. The interpretation of the results obtained by the separate species method, as applied to well waters in Colombo, is rendered difficult owing to the persistence in the soil of two resistant lactose fermenters. The number of *B. coli communis*, however, affords a valuable index of the quality of these well waters.

The results of the bacteriological examination of Colombo wells usually indicate less pollution than the figures for the chemical analysis, particularly the amount of albumenoid ammonia. Nitrites are very frequently present in these waters, and have been considered as evidence in favour of recent pollution. As a result of experiments with artificially nitrated waters, of the results of bacteriological analysis, and of topographical considerations, the writer concludes that the presence of nitrites in Colombo well waters is more often a sign of old than of recent pollution, and that traces of nitrite are readily produced by the reduction of nitrates to nitrites by reducing salts of iron present in the soil.

With regard to the question of standards for bacteriological water analysis, it is much more important to come to some agreement as to the selection of the methods which are to be made standard for the bacteriological analysis of different classes of water, than to discuss the standards which are to be applied to the results of a number of different methods. Numerical standards are perhaps best applied to the results of the bacteriological analyses for the control of filtration works, or to the results of analysis of waters whose bacteriology has

been closely studied. Even here, the standard usually needs to be specially adapted to the particular water, and to be varied at different seasons of the year. It is necessary to constantly emphasise the truth that in interpreting the results of either chemical or bacteriological examination, topographical considerations must always be given the fullest possible weight. For the detection of accidental pollution for water of known constitution, which is constantly subjected to routine tests, the estimation of the number of Lagin micro-organisms per c.c. is all that is usually necessary. The choice of a suitable primary medium and cultivation time must be determined by a study of the biological character of the water; for general purposes the lactose bile salt broth of MacConkie is most useful.

Where it is desired to make a complete study of an upland surface water by a bacteriological method with a view to forming an opinion as to its potability, or the degree of filtration or storage likely to be required to render it safe for human consumption, it is advisable to proceed on the lines recommended by Clemesha. A comprehensive bacteriological study of the water under all conditions should be made. Any possible source of dangerous or accidental pollution suggested by inspection on the spot should be subjected to careful investigation by bacteriological methods. The methods recommended by Clemesha for the study of self-purification processes are, I consider, capable of much simplification by the use of solid media for the estimation of the total glucose fermenters. In the case, however, of waters containing a large number of organisms, capable of spreading in the substance of an agar plate, this method could not be used.

Dr. Hirst:—I have attempted to describe in my paper the evolution of suitable methods for the bacteriological examination of certain surface waters in the vicinity of Colombo.

There is a great similarity in the problems which confront the water bacteriologist in all parts of the world. On the other hand, there is often a great dissimilarity between the bacteriological methods which are best adapted to the solution of these problems.

The bacterial flora of the fæces of man and the lower animals undoubtedly differs in different localities. In this connection I should like to draw attention to the table on page 5 of the paper, giving the percentage grouping of ærobic fæcal lactose fermenters isolated from the fæces of man in England, India and Ceylon.

The anærobic fæcal organisms predominant in human fæces are undoubtedly different in England, Ceylon, and probably the United States of America.

Major Clemesha has brought forward evidence to show that there is a definite seasonal variation in the microbic content of the fæces of man and animals in India. I have not hitherto been able to discern any such seasonal variation in Ceylon. I think it probable that in all parts of the world the general type of coliform organisms most common in the fæces of man are those fermenting lactose vigorously and producing indol in peptone water rapidly. The various organisms of this group, which includes the *B. coli communis*, are certainly by far the most numerous in the fresh fæces of man in England and Ceylon. The relative distribution of the various species of lactose fermenters inhabiting the human intestine varies greatly for reasons that are not yet fully understood.

I find the quantitative estimation of "Lagin" organisms to be the safest guide to the actual amount of fæcal pollution in a particular water. The method I employ is a modification of that recommended by Houston.

The recent researches of Houston, Greig and others on the viability of uncultivated pathogenic organisms, such as cholera and typhoid, have emphasised the importance to be attached to recent, as opposed to remote, fæcal pollution of water-supplies, and the danger of

sudden accidental pollution of comparatively pure waters by human carriers. The development of efficient bacteriological methods for the detection of recent pollution has become more than ever necessary. MacConkie's separate species method has proved very serviceable for the detection of recent pollution in Colombo waters. I have found the technique devised by Major Clemesha for the isolation of the separate species very satisfactory in practice.

During the process of the self-purification of a polluted water the lactose fermenting power of fæcal organisms is attenuated to a greater degree than is their power of fermenting glucose.

Estimations of the vigour with which lactose is fermented in fluid media inoculated with polluted water, and of the relative number of glucose and lactose fermenters in the water, afford valuable criteria for estimating the age of the pollution.

I have found the method described in the paper less cumbersome than that advocated by Clemesha.

There is urgent need at the present time for the selection and standardization of suitable methods for the bacteriological examination of different classes of water. The application of standards to the results obtained by the various methods selected could then, and not till then, be profitably discussed. Studies in the bacteriology of water to any particular locality should always be accompanied by periodic analysis of the faeces of man and the lower animals in that locality. In the interpretation of the results of the bacteriological examination of water-supplies the fullest weight must be given to topographical considerations.

In conclusion I should like to make a few remarks on the significance of the detection of vibrios in polluted waters.

Recently, an outbreak of cholera occurred along the banks of a canal in Colombo. This canal received the major portion of the drainage from the infected area, and is extensively used for bathing and washing clothes. I was able to isolate vibrios from this water morphologically similar to the cholera vibrio. They turned out to be materially different, biochemically and biologically, from the true cholera vibrio. As soon as these vibrios were found the traffic along the canal was prohibited and the banks policed. Six days later no vibrios of any kind could be detected in the water.

Doubtless it may be a coincidence, but the fact remains that no case of cholera has since occurred in Colombo. This is the only occasion on which I have found vibrios in Colombo waters, though I have looked for them repeatedly.

It seems to me possible that there may be factors operating occasionally in favour of the survival of cholera in a water,—such for example as a favourable chemical constitution or physical condition of the particular water, or a favourable symbiosis with other organisms. The detection of allied vibrios might conceivably turn out to be evidence in favour of the operation of such favourable factors. In any event I consider that the presence of cholera-like vibrios in a water is weighty evidence against its fitness for human consumption.

Dr. R. C. Bose said that standards were badly wanted and until these were obtained, it was impossible to say definitely what water was fit to drink and what was not.

Major Clemesha :—Referring to Dr. Hirst's paper, I should like to say that it is particularly gratifying to me to know that practically all the essential points that we laid down in the Madras Report of 1910 have been confirmed; some very valuable modifications have been suggested by him which all tend to simplicity. His suggestions given on page 9 concerning the results obtained from a 24, 48 and 72 hours' inoculation of waters in lactose broth are particularly valuable, because he has taken with the ordinary method of testing what is known as the acid and gas line which in glucose and lactose is extremely complicated.

and this seems apparently to do away with a very large amount of laboratory work. He tells us that the results tally to a very considerable degree, and that being so, it is a very great advantage, because it gets rid of a very large amount of work. There are several points in the paper we would like to discuss, but I think the time is hardly sufficient. They are rather matters of laboratory detail which perhaps would not interest a very large number of people. But there is one point at the end. I particularly wish to endorse his remark, 'I consider that at the present moment it is much more important to come to some agreement as to the selection of standard methods for the bacteriological analysis of different classes of water, than to discuss the standards which should be applied to the results of a number of different methods.'

I think in the Conference in Bombay I urged very strongly that there should be some understanding between the laboratories in India, and anyone else who may like to join in, as to a standard method of doing the work. It is obvious to all that the method at present is extremely imperfect. Everybody finds it very complex and with a certain amount of justification. I should like particularly, if possible, Sir, that that point may be incorporated in a resolution, because I feel we shall not make any very great progress unless we are all working more or less on one method, and each man in his own particular laboratory finding out the advantages and disadvantages of it for his own particular locality. The standard of the purity of water I believe myself to be entirely a counsel of perfection. Unfortunately Major Liston is not here to-day. He has a very long series of analyses taken weekly from the laboratory in Parel, and he says the conclusion of all his work is that it is absolutely impossible to draw any real conclusion as to the quality of the water. He finds a very large amount of fæcal contamination in those samples, and he says, on the other hand, that the water in Bombay is perfectly potable and perfectly good. My own impression is that in his particular case the reason is due to the fact that he has used samples that have come many miles down. The pipes are not particularly clean; many of them have an incrustation in them, and it is well understood that pipes with an incrustation give very extraordinary bacteriological results. Personally I think that many of his results can be accounted for in that way, but at any rate, whatever the cause may be, I think it is absolutely necessary that we should all be working on one particular line, and comparing our results with those that are obtained from different places. I feel sure that a certain proportion of the work which we do at present in laboratories will have to be either simplified or done away with altogether.

THE PRESIDENT :—One point, Major Clemesha. As regards your statement about the inquiries into water analysis. You remember there were three points that we decided should be considered :

(1) What are the best methods for water examination in India?
(2) After having settled that to fix bacteriological standards.
(3) The most suitable methods of conveying samples to distant laboratories.

Do not those terms of reference meet your views ?

MAJOR CLEMESHA :- Entirely. It would be of considerable advantage now if a special commission were appointed to inquire into these points. Everybody who is doing water work now should more or less try to work on the same lines.

THE PRESIDENT :—You do not object to these terms of reference ? (Major Clemesha :—No.) Of course, you know that the reason why the inquiry is being held up, is that Major Hutchinson was appointed Sanitary Commissioner just when the experiments were to be undertaken ; and we are waiting to appoint someone else. (Major Clemesha :—I did not know of this.)

MAJOR R. MCCARRISON: In connection with Dr. Hirst's instructive paper, I would crave your indulgence while I refer very briefly to two methods of purification of water-supplies for small communities of which I have some experience. I refer to the disinfection of water by chemical substances. Of these I have employed iodine, after the method recommended by Captain Nesfield, I.M.S., and the hypochlorite of lime method, both in the case of the Lawrence Military Asylum at Sanawar. The former method consists in the addition of a mixture of potassium iodide (1 pt. by weight) and potassium iodate (4·5 pt. by weight) and of tartaric acid, to the water, so that free iodine is generated in the proportion of one part of iodine to 70,000 parts of water. The iodine after it has been allowed to act upon the water for a certain length of time is got rid of by hyposulphite of soda to which 2% of carbonate of soda has been added. This iodine method [which is described by Captain Nesfield in the Journal of the R. A. M. C., May, 1912,] is a very effective one, but I found in practice that the taste of the water was altered by the iodine, and that complaints were not infrequent. For this reason, and also from the point of view of expense and greater efficiency, I prefer hypochlorite of lime as a chemical purificant of water. I obtained from Messrs. Burroughs and Welcome sealed tubes of dry hypochlorite of lime containing 35% of available chlorine; 200 grains of this chemical are mixed with a little water and the mixture added to 400 gallons of water,—this being the daily consumption of water amongst the children to whom the purified water was to be given. After the hypochlorite has been thoroughly mixed with the water, and had acted on it for 10 minutes, a mixture of hyposulphite of soda (200 grains) and potassium iodide (40 grains), previously dissolved in some of the chlorine water, was added to the 400 gallons and thoroughly mixed therewith. The process costs 1*s.* 2*d.* or 14 annas for every 400 gallons. (The cost of the iodine method being 2*s.* or Rs. 1-8). It is, therefore, exceedingly cheap. I have had no complaints of the water having been altered in taste by the chemicals used. That it is very effective is shown by the results of bacteriological examination before and after treatment:—

18*th July*, 1913.—The untreated water contained 15,800 micro-organisms per c.c., presumptive B. coli tests were positive in ·1 c.c. and typical B. coli were present in ·1 c.c. After treatment the water contained 4,200 micro-organisms, presumptive B. coli tests were positive in 10 c.c. and typical B. coli were not found in 10 c.c. of the water.

6*th August*, 1913.—The untreated water contained 14,000 micro-organisms per c.c. Presumptive B. coli tests were positive in ·1 c.c. and typical B. coli were found in ·1 c.c.

After treatment the water contained 2,400 microbes per c.c. Presumptive B. coli tests were positive in 100 c.cs., while typical B. coli were not present in 100 c.c.

15*th August*, 1913.—The untreated water contained 2,800 microbes per c.c. Presumptive B. coli tests were positive in 10 c.c., while typical B. coli were found in 10 c.c.

After treatment the total number of microbes present per c.c. were 280. Presumptive B. coli tests were positive in 100 c.c., while typical B. coli were not found in 100 c.c.

Bacteriological examinations were also carried out to test the efficiency of the iodine method, and on these tests (3 in number) the chlorine method appeared to be the more effective of the two. Both chlorine and iodine appear to have a selective action on the bacillus coli communis (and possibly, therefore, on coliform organisms generally) as none were isolated from the smallest quantity of water showing acid and gas. I am indebted to Mr. Fox of the Pasteur Institute of India for these bacteriological findings.

We have, therefore, in chlorine a rapid, inexpensive, and highly efficient method of ridding water of harmful micro-organisms. It is

a method which can with advantage be combined with other methods of purification, and its practical utility is undoubted.

The chlorine method is one which is employed largely in America. I find from the Engineering Record of 1912, page 297, that it is stated, by Jenweys, to be used in between 300 and 350 towns of America. He gives statistics for a certain number of these towns, showing its beneficial effect on the mortality and morbidity of typhoid fever, and he asserts that it has been the means of arresting epidemics, and certainly has prevented the spread of a great number. He concludes from this very large experience that chloride of lime, owing to its cheapness, the ease with which it can be employed, and its rapidity of action, is of the greatest value in the purification of water.

In India especially its employment is peculiarly applicable to the water-supplies of small communities and private institutions, and as a method of purifying the water-supply of armies in the field or of single units, it probably has no equal.

I have ventured, therefore, to make mention of this method as complementary to the interesting and instructive information which has been given us by Dr. Hirst.

MR. MONTGOMERY :—Might I point out that for the Punjab three annas per hundred gallons for the purification of water would be absolutely prohibitive.

MAJOR MCCARRISON :—It cost us 14 annas a day to supply water for the Sanawar school.

PRESIDENT :—I understand your point is that you recommend it for small communities only and not for general use.

MAJOR MCCARRISON :—Yes, Sir, for communities such as schools.

MR. WEST :—For large communities in the United Provinces including pumping, our charges are only 2 annas per thousand gallons.

MAJOR MCCARRISON :—This method is employed in over 350 towns in America.

MR. DYER :—With regard to the treatment by hypochlorite of lime, I may say that in Cheltenham and Scarborough in England there are two large installations where they treat all the water with hypochlorite of lime, and the cost there is only 6 pence per thousand gallons.

DR. HIRST :—With regard to a remark of Dr. Bose's, I understand him to say that typhoid bacilli may under certain conditions survive for as long a period as 72 days. I think those figures must be based on experiments with laboratory cultures rather than the uncultivated organisms. With regard to the ease of simple estimation of the number of lactose fermenters as a criterion for estimating the real pollution of water, I don't think that the mere estimation of the number of lactose fermenters is sufficient in itself, without further tests, to enable one to express any confident opinion on the potability of a water.

(*b*) *Filtration of Water.*

MR. W. HUTTON introduced his paper "Experiments in the filtration of water through slow sand and mechanical filters at the King Institute, Madras,"* and said:—My paper gives a brief description of experiments which have been carried out with two small sand filters. and two mechanical filters at Guindy, Madras, in order to come to some conclusions as to the relative merits and suitability of these different types of filters, and to show whether the statements which have been made were correct, that the depths of the sand filters in general use in the Madras Presidency were excessive and might be reduced with advantage.

The results obtained are somewhat variable. That is to say, the analyses of the filtered water show variable results. It has been proved, as previously thought, that sand filters are very satisfactory means

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of filtration provided the water to be filtered is sufficiently clear and not so turbid as to block or choke the sand filter in a short time, and thus interfere with the operation of filtration. When the raw water used for filtering purposes was turbid it was found that the mechanical filters were successful in removing the turbidity and thus have a distinct advantage. On the other hand when the river water was turbid, the filtrate from slow sand filters was found to be cloudy or opalescent in appearance. To prevent this cloudiness in the filtrate, it would be necessary to add to the sand filter installation, settling tanks of ample dimensions, with or without the preliminary addition to the raw water of a coagulating chemical, such as sulphate of alumina.

One important result of the experiment is that it has been shown that with comparatively clear water sand of a relatively coarse nature can be used with advantage, and that when sand of a greater degree of fineness is used, the filters rapidly clog up. Fine sand in a filter has this decided practical disadvantage and the disadvantage would be greater if the raw water be turbid.

It will be noticed on page 4 of my paper that the leakage of sub-soil water into a sand filter is given as the probable cause of the bad results obtained from analyses of the filtrate. Instead of using the word leakage, I should have stated that the bad results were probably due to diffusion of sub-soil water into the filter. This opinion has been confirmed, it is thought, by the repairing of the cracked floor of the Vizagapatam filters and by the construction of two new filters at the Coconada water-works. At Coconada the old filters were found to be very badly cracked, thus permitting the contamination of the filtered water from the sub-soil water which was only a few feet below ground level. On the other hand, the filtrate from the new Coconada filters was found on analysis to be satisfactory, and these new filter beds were found to be water-tight on testing.

The experiments at Guindy are still continuing. At present we are experimenting with a rate of flow of 300 gallons per square yard, instead of the 450 gallons per square yard, which has been our rate previously. Apparently the 300 gallons rate permits of a longer period of working between scrapings but data are not available. When this test has been completed we will experiment with a 600 gallon rate. I also propose to put a thermometer at each plate glass window of the sand filters and to keep a record of the temperature of the unfiltered water.

I regret to notice that I have omitted to give the results of the chemical analyses. These showed the presence of lime in sufficient quantity to give a satisfactory coagulant with sulphate of alumina in the coagulating tanks of the mechanical filters. Results of analyses are available from the 3rd of March and samples are being regularly taken. The analyses results shown in the paper were given as they were thought to be sufficient for the purpose of a short paper, and permitted of comparison.

Owing to the work devolving on the King Institute the number of samples taken in one day had to be limited, and it was not always found possible to run all the filters at one and the same time when more than one sample had to be taken from each sand filter.

The results of the analyses were discussed with Dr. Gibson, the Director of the King Institute, up to the date of his departure on 6 months leave, and his opinion was understood to coincide with my own that sand filters were to be preferred to mechanical filters in ordinary circumstances, such as for filtration of non-turbid waters. Dr. Gibson's opinion was considered of special value as he had carried out for some years the analyses of the water of water-works in the Madras Presidency.

It is unfortunate that his absence on leave prevents his presence here as a delegate to this Conference, but on his return next month his

opinion of the results will be obtained and forwarded with the report which the Madras Government have ordered me to submit.

MR. WILLIAMS :—Mr. Hutton seems to me to wish us to accept his conclusions on somewhat flimsy evidence. Considering that these works have been in operation for more than a year, the amount of definite information he gives us in the paper is very small. The actual analyses, on which he wishes us to accept his statement that considerable depth of gravel in slow sand filters is essential, are five—two of them from one filter and three from another. These were all taken within a few days of each other. It is not at all clear as to what arrangement of taps he has made, nor how they are fixed. If the taps merely pass through the wall, the analysis of water is likely to be highly misleading, for, as Mr. Hutton has himself pointed out, there is a large amount of creep down the wall and the water obtained from the edge of the sand is not necessarily at all of the same quality as that obtained in the sand bed. It is therefore very important that we should know exactly how the connection is made between the taps and the interior of the filter. I do not quite know what particular form the controversy between the advocates of deep gravel beds and shallow gravel beds has taken in Madras, but I presume the objection to excessive thickness of gravel is largely on economical grounds. The main function of a gravel bed is a mechanical one—to support the sand, and it is therefore a waste of money to make it deeper than is absolutely necessary. Six inches or a foot of gravel has been proved to be quite sufficient to allow a proper discharge from the sand-bed to the under-drains, and this I think is, in the opinion of most engineers, quite enough gravel to put in. To deepen one's filters by an excessive layer of gravel for the purpose of getting some slight possible extra purification appears to me to be rather like the method adopted by the Chinese of burning down a house to roast a pig. Any comparison between the action of the gravel underneath a sand filter with the action of a sewage filter on the highly polluted effluent which the latter has to deal with is, of course, entirely irrelevant and misleading. The result of the action of a sewage filter is chemical rather than bacteriological, whereas the water filter is exactly the opposite. I am pleased to hear that Mr. Hutton is now proposing to reduce the rate at which he is working his filters, for the rate of 50 gallons per square foot, which is what these slow sand filters are worked at, is exceedingly high, considering the very inadequate nature of the settlement. It is not surprising that a fine sand filter clogs in a few days, nor is it surprising that some of the results were so extremely bad. In Bengal where the average rate of filtration is 40 gallons per square foot, and a settlement of 48 hours is generally given, sand considerably finer is in operation in almost all our municipal water-supplies. And, on the whole, except when a river is exceptionally turbid, we do not find that these require scraping at unduly short intervals. In regard to the mechanical filters, the result of experiment seems to have been, mainly, that with a turbid water 2½ grains to 3 grains of sulphate of alumina per gallon is required to give good results. This is what I have found elsewhere and it shows (what is also to be found in other places) that a very soft water with which this amount of coagulant cannot be adopted is not a satisfactory type of water to be used in mechanical filters.

MR. MADELEY :—I must congratulate Mr. Hutton on the very interesting paper that he has submitted to us and, now that the initial expenditure of installing two sets of sand filters and two mechanical filters has once been made, I trust that these experiments will be continued by a combination of engineers working in collaboration with bacteriologists. I am sure that they will provide us with information of the greatest value for there are still a number of points which require elucidation in connection with the filtration of water in India.

Turning to the paper itself and dealing with the points as they are taken up by Mr. Hutton, there is first of all the ques-

tion of samples. I wish to ask the same question as Mr. Williams. Mr. Hutton says that to enable samples to be taken from different depths in each filter so as to show the effect of the filtering material on the quality of the water, ½ inch test cocks were inserted in each filter side wall and numbered from 1 to 6. The question is, how far did the pipes connecting with the cocks project into the filter bed material? I rather gather that they did not project more than an inch or two. I suggest that the anomalous results may have been caused by water creep which would affect samples so taken. I would further suggest that experiments should be made to eliminate this water creep. This same water creep will probably explain a peculiar result. Mr. Hutton mentions that the water at the outlet is not so pure as the water taken from the body of the filter bed. I would here remark that the method which has been suggested of putting in a ledge in the material is an unsuitable one. By that means you get the sand irregularly compressed, and dropping away from under the ledge. The method I am adopting, which I think was first started by Mr. Rutter who is in charge of the southern section of the London Water Works, is that of carrying the sand right down to the bed. You carry the sand down to the bottom of the filter for some three or four feet from the sides so that the water has to pass through a layer of sand in any case.

Mr. Hutton mentions the fact that in a filter with only two feet of water over the sand the growth of algæ is very much greater than in a filter where there is a greater depth of water. This is a result which has been found elsewhere.

In dealing with the question of the period of working filters we come on to the debatable point of the fineness of the sand. Mr. Hutton says that the water dealt with was highly impure, and would not have been used for permanent water-works, or only after double filtration. It is important in submitting the results of these tests I think to give full particulars of the conditions of water met with. To the best of my knowledge the impurities referred to are due to *dhobies*. If that is the case, it is probably the soap and grease and other impurities that come from these washing places that cause the clogging of the filters. Further on Mr. Hutton says that the short period which the sand filters worked was due partly to the quality of the water which, although usually clear, deposited a slimy layer of considerable density in a comparatively short time. That would all tend to show that it was due to the soap or fat in the water, and it would appear to follow that these results, although tending to show in what direction filters should be made, should not be accepted as conclusive for every water. It is quite possible that a considerably finer sand might be used, and would work without cleaning for quite as long or even longer, if this soap were not present. I find that there is a great deal of difference in practice as regards the fineness of sand. The practice in England is to use coarser sand than that we find used in Calcutta or Howrah, or in Cawnpore.

Mr. Madeley then gave a description of the qualities of sand used in Birmingham, Bolton, London and Calcutta, and continuing said :–

With reference to the question of depth of the gravel, it is usual now to make the broken stone underlayer as shallow as possible, for financial reasons. Mr. Hutton says with reference to the depth of sand: 'If there were no improvement in quality of the water in passing through the sand-bed, then it would be unnecessary to have this bed any thicker than say a few inches, which would be sufficient to support the slimy layer. In that connection it is found in practice that a certain depth of sand is required because it produces a steadying action.'

Mr. Hutton also makes one point which is a new one. He refers to the desirability of having a wall round the filters, and says that this should be 2 feet high. This agrees with my experience and observation, and I am constructing one round the Madras filters. With regard

to the depth of sand, I see Mr. Hutton refers to a minimum depth of two feet in thickness. That minimum is rather high and I should like him to say why he adopts this high minimum depth. I should like in this connection to ask if any delegate has had any experience with the washing of sand. There are two methods. One is to skim off the sand when it has reached its minimum depth, and the other method is to skim it, wash it and replace it at once. One advantage of the latter method is that you always get the same depth of sand.

I suggest the following points to be taken up for investigation :—

(1) The prevention of water creep ;
(2) The benefits of increasing the head considerably :
(3) The rate of filtration. I was glad to hear that Mr. Hutton was going to try to increase the head by 50 per cent.

SIR PARDEY LUKIS :—I would like to call your attention to a statement made by Sir Harcourt Butler in his introductory speech to the effect that the Research Fund Association have placed a sum of a lakh and a half of rupees at the disposal of Sanitary Engineers to carry out an elaborate practical experiment in water filtration at Benares. The object of this experiment will be to ascertain first of all the best methods of silt removal, and next to determine the relative merits, under varying conditions, of different types of mechanical filters and of sedimentation, both with and without the addition of chemicals. The details of the proposed investigation will be explained to all of you who are going to Benares on Sunday next and any suggestions that delegates may wish to make then as regards the modification or improvement of the experiment will be most carefully considered. That is one of the reasons why we want to go to Benares, so that you may discuss on the spot these practical experiments that we propose to carry out.

MR. WEST :—I should like to say a few words in connection with the paper on sand filters. One point I wish to refer to is as regards the minimum thickness of gravel. We have got about 40 filters in these Provinces in which the thickness of gravel is only two inches. The filter consists of two layers of bricks and then two inches of gravel, over which there is 6 inches of coarse sand and about two and a half feet of fine sand. We have got one or two filters with 6 inches of gravel but we have found no improvement in the results with a thicker bed of gravel. As regards the thickness of the sand, we have made experiments with 2½ feet and 3 feet, and we have sometimes got down to 8 inches, and we have found no deterioration in the results when we have a uniform flow. Our usual practice is to refill after it falls to 18 inches, but we found on one occasion an 8-inch thickness of sand gave quite good results. All our filters are worked after 24 to 36 hours previous settlement. For about 9 months in the year it is purely settlement ; for 3 months of the year, in the rains, we add a coagulant to improve the sedimentation. I have got certain results of 3 months' working at Cawnpore in which the water has been tested every day, and our rate of filtration is between 35 and 40.

In July the average number of bacteria in the raw water was 517 ; in the settling tanks the number was 94, and through the final filters 18·2.

In August the average number of bacteria in the raw water was 454 ; in the settling tanks the number was 181, and through the final filters 17.

In September the average number of bacteria in the raw water was 376 ; in the settling tanks the number was 128, and through the final filters 14.

In October the average number of bacteria in the raw water was 173 ; in the settling tanks the number was 91, and through the final filters 19.

These show very good results with a low rate of filtration; 37·5 is about the average rate. In the hot and dry weather we have sometimes worked individual filters up to 50 to 60 with very good results. but there are very few bacteria in the raw water and very little silt. In some places we do not use a coagulant in the rains for our filters; we just settle the water and put it on the filters. In the places we work at even a lower rate we sometimes get down to 25 or 27 in the rains; I think we can safely work to 40 by previous settlement and the addition of a coagulant.

As regards the washing of the top scrapings, we have found that it is not economical to do so. We always get fresh sand from the river and wash that before putting it into the filters, as the cost of washing the top scrapings is very high. New sand may not be so good, but it is more economical.

MAJOR CLEMESHA said that he seriously objected to the filter being called a Clemesha filter. It was a filter that was being made by the hundreds.

The results obtained by Mr. Hutton from his slow sand filters could not be called at all good; personally he would call them extremely bad. No sand filter which was at work should ever give less than one fæcal organism in 100 c.c. and Koch had laid it down as a principle that no filter should be looked upon as giving satisfactory results which gave more than 100 bacteria per c.c. If they compared these results he did not think they could congratulate themselves on the results of the sand filters in Madras.

The second point that was raised by Mr. Hutton related to the experiments given on page 20 of his paper which showed that there was a progressive improvement of the bacteriological quality of the water as it passed through the sand. If he wanted to show that the majority of the purification had been done in the top layers, some such figures as those published by Mr. Hutton would serve fairly well. It would be observed by looking at the figures (first series) that the water began with 1,360 bacteria; by the time it reached the second tap it was 87 and the time it reached the sixth tap it was still 70. Anybody looking at these figures would certainly not draw the conclusion that there was a progressive improvement of the water as it passed down the sand.

Then Mr. Hutton had gone on to justify the necessity for the deep drainage layers by comparing sewage filters with these filters. But the comparison was entirely unjust. Sewage filters were not filters at all. They were merely arrangements whereby a quantity of effluent was put at the disposal of a maximum number of bacteria. whereas in water filtration the idea was to remove bacteria.

Turning to sand, most of the works on sand gave as a suitable grade, sand which had been passed by a 40 and retained by an 80 mesh. Mr. Hutton had, in his opinion, used an extremely fine sand, and he had never heard of sand of that nature being used in slow sand filters. It was not therefore to be wondered at that his filters were blocked up rapidly. The sand used in Calcutta and Howrah was of about the standard grade. That sand in Bengal gave very satisfactory results, and it tallied with the practice in America and other parts of the globe, where similar results were obtained. They should not consider it at all satisfactory if any slow sand filter were to give them one fæcal bacteria in one c.c. They should require one in 100 c.c. as a standard of purification.

As regards mechanical filters, he felt bound to say that mechanical filters had received very bad treatment at the hands of the people at Guindy. They had not been told in Mr. Hutton's paper what was the character of the water. Mr. Hutton had not told them the actual hardness or alkalinity of the water to which he had proposed to add alum. Water of a hardness of 30 or 40 degrees required alum at a dif-

ferent point and in an entirely different way from a water which had a hardness of 2 or 3 degrees. It was extremely difficult to get a good result from these mechanical filters if the water was above 20 or 30 degrees of hardness. Delegates would probably remember that at the last Conference a very interesting paper had been read by Captain Dunn who showed that he had never succeeded in getting a satisfactory result from a very hard and clear water. He was not at present able to say what the cause of that result definitely was, but he knew from experiments that it was by no means an easy thing to add alum to water of that nature. If it was added too far away from the point of passing it on to the sand the whole precipitate went straight to the bottom and never reached the sand at all, and, on the other hand, if it was added too close, there was a risk of blocking up the sand very rapidly and requiring an extravagant amount of washing water.

He also objected to the description given of some of the details of the Patterson filter. It was an extremely delicate and excellent piece of mechanism, which, in his opinion, had given most admirable results. He did not think many of the conclusions arrived at in the paper were justified by the figures before them. He was glad to hear that other figures would be at their disposal at a later date, but he was quite sure that a great many of the conclusions could not be maintained from the analyses that they had got, and from the very scanty and indifferent working of the filters as they had been found in Madras at present.

MAJOR JUSTICE :—The experiments at Guindy can only be said to have reached a very preliminary stage. There are so many circumstances to be taken into consideration. To quote a few of them: the season of the year must be considered, and secondly the state of the source, which in the circumstances under which our experiments have been carried out, is a river. Now the river at one time is particularly low, and at another time it is liable to huge floods. When the water is in high flood the analysis is particularly bad. but on the height of the flood practically nothing but pure rain water comes down. Again we are not to rest content alone with our present sources. We shall endeavour to test the filters with other waters which are at our disposal at Guindy.

MR. HUTTON : -With reference to the question of the test pipes, these pipes projected into the sand about two or three inches and it was always my intention to carry out an experiment in water creepage upon the sides of the filters, but to my astonishment, although these pipes were projected a short distance into the sand the bacteriological results obtained from them were so good that it seemed to me that the amount of creepage was very little. The pipes I think should now be extended, but I do not expect they will show better results than are shown by these analyses. Major Clemesha, I think, drew attention to the reduction in the number of the bacteria from 1,300 to 87, then to 60, 48, 51. and so on. I think that shows a tendency in the reduction of the bacteria, and, personally, when I found any result which could hardly be explained, I put it down to the system of analysis adopted with which I have nothing whatever to do.

Mr. Williams has referred to excessive depth of broken stone in the under layers. Now there are two systems, I think, of abstracting water from a sand filter. One is by having a considerable depth of broken stone and the other is by the system of brick under-drainage which is illustrated in my paper. Now if you have not got these brick underdrains you must have a minimum depth of stone in order to take the water out of the sand filter. So I don't think Mr. Williams intended to suggest that that depth should be used unless brick under-drains were employed. Some engineers have preferred the one kind and some the other. The tendency at present is certainly towards the brick under-drains.

Mr. West asked a question about the minimum depth of sand—why we prefer two feet? That has always been our practice in Madras and we think it is a safe depth, considering the staff we have to look after our Municipal water-works. Mr. Madeley asked a question about the purity of the river water. The contamination of the water is very evident, as there is a road crossing about two or three hundred yards away and *dhobies* are legally entitled to wash at this place. We consider the water physically impure, as well as bacteriologically, according to the results obtained. I admit that the results of these filters are not by any means complete, but I thought it would be of interest to this Conference if I produced the results as far as we had obtained them. The experiments are still continuing, and one reason why I produced the paper at this Conference was in order to receive suggestions from Sanitary Engineers or Sanitary Commissioners as to how we should continue the experiments.

SIXTH DAY, SATURDAY, 24TH JANUARY, 1914.

SECTION A.

First Session.

Programme of Inspection at Lucknow.

The delegates met at the Diamond Dairy at 9 P.M., and inspected the following :—

(*a*) The Diamond Dairy,
(*b*) the Co-operative Dairy,
(*c*) the water flush latrine at Narhai and pail depôt,
(*d*) Boasganj (village for accommodation of displaced population),
(*e*) conservancy depôt,
(*f*) the Lucknow water-works,
(*g*) a new filter bed controller at the water-works.

The papers presented to the Conference in connection with the inspections of Lucknow were :—

(1) "Note on the working of the Co-operative Dairy Society at Lucknow,"* by Major S. A. Harriss, I.M.S.
(2) "Co-operative Milk Societies," by Mr. R. W. D. Willoughby, I.C.S.
(3) "Note on Lucknow,"† by the Hon'ble Rai Ganga Prasad Varma Bahadur.
(4) "A short descriptive note on Lucknow City Sanitation," by Mr. P. R. Hewlett.
(5) "Lucknow water-works," by Mr. H. I. Carter.
(6) "A new filter bed flow controller.

(The delegates inspecting Lucknow were divided into four parties under the guidance of Mr. ffordе, Mr. Gwynne, Mr. Hewlett and Dr. Sousa, who kindly acted as guides.)

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† „ V.

SECTION B.

First Session.

The Hon'ble Sir Pardey Lukis, K.C.S.I., K.H.S., I.M.S., Presiding.

Plague.

Captain Kunhardt in introducing his paper on "Further investigation into the position of plague inspection in the village of Poona district during the off-season",* said:—"At the last Sanitary Conference a paper was read dealing with the persistence of plague infection in the villages of Poona district during the off-season. The conclusions arrived at in that paper were based on observations made on a limited number of selected villages. These were all villages which happened to have a comparatively short plague-free interval, and it was quite possible that there were others to be found in the Plague Progress Reports of the Government of Bombay, which bridged the off-season though having a plague-free interval of longer duration. The conclusion arrived at in that paper, therefore, required confirmation.

The paper which I now place before you is a further study of the epidemiology of village plague in Poona district; in this case it was decided to observe the subsequent plague history of *all* villages infected in that district in *any* two years. It was hoped that it would also throw further light on the general behaviour of plague epidemics in villages.

The results of these observations are summarised in the table found in my paper—which shows that, in these two years, out of 235 infected places, 178 shewed no epidemic during the subsequent year, and in 45 in which a second epidemic occurred, evidence could be found which suggested re-importation as the source of infection in the second season. Of all the 235 villages only 12, and if three doubtful ones be excluded, only 9 carried plague over the off-season. This works out at only 3·8% of the total number.

The results show, also, that in the larger towns, a plague epidemic, depending on the co-existing rat epizootic, is more prolonged than in the smaller towns and villages. An epidemic in a large town like Poona may commence early in the plague season and yet the number of rats surviving at the end of the season may suffice to maintain an epizootic during the subsequent off-season, a period which in Poona district may be said to extend from April to June inclusive. None of the smaller towns and villages in which an epidemic commenced early (*i.e.*, before January) shewed a recurrence of epidemic plague the following season which could not be explained by evidence of a fresh importation of infection. Moreover, when an epidemic recurred during the second season after the month of September, this also could always be explained by evidence of re-importation from places already infected in their neighbourhood.

With the exception, therefore, of the largest towns, *i.e.*, in all the smaller towns and villages, almost all epidemics are strictly limited to one plague season; when epidemics overlap two seasons, as occur occasionally, it is only in such places as become infected late in the plague season.

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* Volume V.

It must be remembered, however, that a few villages may become infected for the first time during the off-season or immediately previous to it; infection in these may bridge the off-season and yet for various reasons they may return no human plague till the following season has commenced. In the off-season the number of fleas per rat is very small, and the length of their life in a hot and dry atmosphere is very limited, so it is not likely that this would occur very frequently. It is these villages, however, which will give most trouble when attempting to eradicate plague from a district during the off-season, for since they have returned no human cases, there will be nothing to indicate, by our method of observation, the presence of infection amongst rats during that period. One must remember that the figures given in the charts refer to human cases only, it is assumed that, for our purpose, they may be taken as a practical and sufficiently accurate index of the co-existing rat epizootic.

The table to which I have referred throws some light on the limits to which infection is usually conveyed in this part of India, and the importance of railways in the diffusion of the disease. Out of 178 villages most of which are more or less remotely situated, none were infected during the second plague year, whereas amongst 45 into which infection was apparently re-imported in the second year, 15 or 33 per cent. are situated on the railway and 29 (of which 20 are either directly or indirectly associated with Poona city) were probably re-infected from places only a few miles distant.

I should like to call attention to a convenient method I have devised for studying the behaviour of plague epidemics in the villages of a district by means of special 'charts'; these charts are at once a simple and complete statistical, as well as a more or less graphic, record of the plague histories of these places; they have been of great service to me in carrying out these investigations.

By this graphic record we can see at a glance which villages have probably carried plague over the off-season and which have not, and we can compare the proportion of villages which carry plague over in various districts or in different years; we could then also compare the meteorological or other conditions prevailing in these districts or in the various years.

Experience thus gained of the behaviour of plague in any particular district or area during previous years would greatly assist us in future in detecting the villages, amongst those infected late in the plague season, which are likely to carry plague over the following off-season. In many cases these villages will be found to comprise a very small proportion of the total number of infected villages in a large and populous area, and it may well be considered worth while to endeavour to prevent plague from carrying over in these few suspected villages by a small reduction in their rat population, in addition to that reduction already produced by the prevailing epizootic of plague."

THE PRESIDENT:—These suggestions of Captain Kunhardt's as regards treatment of infected villages during the quiescent period are now under consideration, and it is possible that we may decide to carry out an experiment on a big scale under the auspices of the Research Fund. I hope, therefore, that all delegates who are interested in this matter will discuss these papers fully so that we may have all information at our disposal when we decide whether to carry out those experiments or not.

CAPTAIN GILL:—In connection with Captain Kunhardt's paper, I should like to mention that in 1910, as a result of the deliberations of the Punjab Plague Committee, the Punjab Government decided to adopt the policy outlined by Captain Kunhardt. They asked that efforts should be made to discover the localities where plague existed during the quiescent period, and in those places very thorough rat destruction campaigns should be carried out. It is to be hoped that before

long information will be forthcoming as to the measure of success which has attended this policy, for it appears, now more than ever, that the only possible way of dealing with plague by means of rat extermination is by stamping out infection at the time when only a comparative few villages require to be dealt with.

LT.-COL. BROWNING SMITH:—I am sure all those interested in plague and especially those who are engaged in fighting the disease in the field will feel very grateful to Capt. Kunhardt for his valuable papers and read them with the greatest interest.

This problem of the carrying over of infection from one annual epidemic to the next is one of the greatest importance, indeed, I look upon it as the key to the position, and it will not be until this problem is thoroughly elucidated that we shall be able to grapple with plague successfully.

So important is it that I would suggest that if any resolution is issued, that we should recommend a thorough investigation into the subject in all provinces or local administrations where the disease is prevalent. It is a subject in which I personally take the greatest interest and some of you may remember that I have submitted papers to previous Conferences on the subject.

Capt. Kunhardt proposes an experiment directed to preventing this carrying over of infection, and completely obliterating plague from that area. I confess I am somewhat sceptical as to the complete eradication, but such an experiment cannot but do good, and many dangerous diffusion centres will be abolished, moreover, more light will certainly be shed on the subject and I earnestly hope that the experiment will be carried out. In the area dealt with by Capt. Kunhardt, I note that he considers that very few places carry over infection; if this is so, there is a good chance of his experiment proving completely successful. In the Punjab, I regret to say, the problem is not so simple or I feel certain we should long ago have abolished plague, for we have been working on these lines for some years.

It will be seen from our plague manual and the directions issued annually to the plague staff, that for some years attention has been particularly directed to those places where signs of infection persist through the off-season, and to places infected late in the epidemic season, so that it can hardly be said that Capt. Kunhardt's proposals herald a new departure in the case of the Punjab, whatever it may be as regards the rest of India; indeed, it appears to me that the Punjab Plague Handbook exhibits a very curious and rare anomaly, the older it gets and the more we learn about plague, the more up-to-date it seems to become.

There is no time for me to discuss the subject at all fully, but, as it may prove helpful in case the experiment is carried out, I may perhaps be permitted to call attention to one or two points which have been impressed on me after watching the rise, fall and reappearance of many annual epidemics:—

(1) places where plague is manifest throughout the off-season are of course important but they are not the chief origins of the succeeding epidemics, *vide* the two maps in the proceedings of last year's Conference. The rats in fact have been so severely dealt with that when the epidemic season comes on there are not enough left to produce a smart epidemic; these are comparatively slight diffusion centres;

(2) conversely, the less the village is attacked at the end of the plague season and during the off-season, the more serious will be the epidemic when plague activity is resumed; these are bad diffusion centres;

(3) the most dangerous of all are those places into which plague is imported late in the plague season with little or no

result at the time; this not infrequently occurs, and the official returns may give no clue to the presence of plague. They will, therefore, be missed altogether and not come to notice till the epidemic breaks out.

As regards the question whether or not reappearance without fresh importation can be delayed till the epidemic season is well advanced, I am convinced this occurs in the Punjab at times; the picture displayed by such outbreaks is quite different to that following importation, where plague gradually spreads from the imported focus; it is a more or less irregular and diffuse appearance in different and unconnected places, sometimes three, four or more persons being simultaneously attacked on the first day. I need hardly say that these features will not be elicited from the reported figures, and so are a good illustration of the danger of formulating assumptions upon the official returns without any investigation into the actual facts.

CAPTAIN KUNHARDT then introduced his second paper, "Plague prophylactic measures during the off-season,"* and said:—In attempting to eradicate plague infection from a district during the off-season it is extremely important that we should be able to detect, in a simple manner, the places when the disease prevails during that period. I think I have shown, in two papers dealing with the persistence of plague infection during the off-season, that only a very small proportion of the places infected in any plague year, harbour the disease during the subsequent off-season in Poona district. This persistence of the disease depends chiefly on two factors; on the size of the village, and on a late implantation of infection. It also appears that, apart from railways, plague infection is usually transported, at any rate in this part of India, to very limited distances, so that when a large area has once been rendered free from plague there is reason to hope that it may not again become infected for some time afterwards.

This paper, based on our present knowledge of the epidemiology of village plague, suggests a method for detecting and dealing with the few villages which harbour infection during the off-season in the districts of Poona, Ahmednagar, Sholapur and Satara, with the object in view of eradicating the disease from this part of India.

It is pointed out that the diminution in the rat population produced by plague is the natural means whereby an epizootic is brought to a termination, and, therefore, a small additional reduction in the number of rats during the off-season when climatic and other conditions are most unfavourable for the disease, should suffice to eradicate plague from these places. If successful, this would render a large area free from the disease, and even should it not succeed completely in the case of every village the number of *foci* of infection in this area would be considerably diminished and the plague mortality thereby reduced.

With fewer villages infected in the following plague season there would probably be fewer also during the subsequent off-season, in fact when we have once got plague in the district well in hand such prophylactic measure as I have described will probably be very easily carried out. In this paper it is shown that the severity of plague in the above mentioned area, as well as in the whole of India, has been steadily diminishing during the past 5 or 6 years; it is important to bear this fact in mind, for in former years when the whole of this area was extensively infected it was quite impossible to hope for success from prophylactic measures except such as were merely palliative, whereas with a steadily diminishing severity of plague epidemics the eradication of the disease from large areas should become less difficult in future years.

I have shown, I think, in my paper that, with the assistance of the special charts which I have already mentioned, and with the experience already gained in the behaviour of plague epidemics in this part of India,

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I can, except in the case of a few of the largest towns and cities, at once exclude all places infected *early* in the plague season, *i.e.*, before January, as practically certain to be plague-free at the commencement of the following season and these places would, therefore, require no rat destruction. Of those infected *late* in the season, I am able to exclude the great majority as unlikely to require more than observation or enquiry during the following off-season. For example : neglecting all localities infected earlier in the plague season, 212 places in the above area showed the presence of infection comparatively late in the season, (*i.e.*, during the period January to June) in certain districts and in certain years. On examining the plague histories of these places during that period 31 were marked down as likely to have required immediate rat reduction operations in order to eradicate plague. On examining their subsequent histories, 12 of these were afterwards found to have bridged the off-season. Of the remaining 181 places marked as likely to require merely observation and enquiry only *one*, a very small village, was afterwards found to have carried plague infection over the off-season period. As this place was marked on the chart as requiring strict observation and enquiry, there can be little doubt that the presence of infection in this place would have come to our notice in time to deal with it successfully.

By thus limiting the number of places which would require rat destruction operations during the off-season, measures for the eradication of plague infection would be facilitated, and the labour and expense which they involve would be greatly reduced.

The year 1912-13 happened to be a particularly mild one for plague in the above mentioned area. In Sholapur district there was no plague, and in Poona, Ahmednagar and Satara districts there were only 47 places which shewed the presence of infection, in the period January to June. An attempt was made at the end of the off-season of last year to estimate the number of places that would require rat destruction with a view to eradicate plague during the quiescent period. We had no other information at the time to show which places were about to carry over infection. The result is as follows :—

The number of places which would require immediate rat destruction was estimated to be	8
The number of places which would require strict observation and enquiry ...	7
The number of places in which a few local enquiries would probably suffice ...	32
TOTAL ...	47

Information which has subsequently come to hand shews that of the eight places marked for rat destruction, infection was carried over in five. Of the seven places marked for strict observation and enquiry, infection was carried over in only one, and of the remaining 32 in which it was considered that only a few local enquiries would suffice, not a single village bridged the off-season.

In two appendices attached to this paper further evidence is found supporting some of the conclusions arrived at in the former paper entitled : "Further investigations into the persistence of plague infection in the villages of Poona district during the off-season," and in the second appendix it is shewn that these conclusions will apply to the villages of the districts of Ahmednagar, Satara, and Sholapur, as well as to those of Poona district.

CAPTAIN CAMERON said he recognised the value of Captain Kunhardt's papers and charts, but he thought that no systematic policy could be based on them without local enquiry. He thought that the districts of Ballia, Azamgarh, Gorakpore and Ghazipore would be a favourable locale for further enquiry, and pointed out the extraordinary facility with which plague infection survived the off-season in these districts. He endorsed all that Colonel Browning Smith had said about the infection of towns. In the United Provinces they could hardly afford to pay attention to towns where the mortality is so small in

comparison with villages in which 20 or 30 per cent. of the population may be wiped out in a month or six weeks.

CAPTAIN GRISEWOOD :—Both Captain Kunhardt and Colonel Browning Smith have called attention to the importance of certain villages in which the rat population becomes infected late in a plague season, but which may not show human cases until the commencement of the following season.

Although such villages actually afford instances of infection being "carried over," yet it is only in very exceptional cases that they can be distinguished from re-infections. Such an instance occurred in the Central Provinces last plague season. During the months of July and August 1912, the province was entirely free from plague. The first place to become infected at the beginning of the season 1912-13 was the village of Hirdepur in Damoh district. This village had not been infected in the previous year, and careful enquiry failed to elicit any possibility of fresh importation. The village, however, is only 2½ miles from the town of Damoh which had been infected during the early part of the year. A number of refugees from the town had formed a camp immediately on the outskirts of the village and had remained there until the epidemic in Damoh had subsided at the end of April. I think, there is no doubt that these refugees carried infection to the village, which however confined itself to a mild rat epizootic until the following September when conditions again becoming favourable, the disease increased and spread to the human population.

MAJOR GLEN LISTON :—I think Colonel Browning Smith drew attention to a very important point which will have a considerable influence on the success or otherwise of Captain Kunhardt's scheme. I refer to the difficulty of recognising the villages in which plague is present during the quiescent season owing largely to defective registration of the causes of death. I understand that in the Bombay Presidency, for example, daily return of plague deaths in villages is enforced. The village officials have to arrange to send information daily to the mamlatdar. This, without doubt, causes much inconvenience to the village officials and they are reluctant to declare a village infected when there is the remotest possibility of an error in the diagnosis of the cause of death. Not until a number of deaths have occurred, often weeks, sometimes even months, after infection was first introduced into the village, do the village officials make up their mind to send daily reports of plague deaths. The daily reporting of plague deaths therefore in place of facilitating the early recognition of plague infection in a village results rather in late recognition of plague infection. I consider therefore that the question of devising some means for the early recognition of plague cases is very necessary before Captain Kunhardt's scheme can be carried through.

DR. KAILAS CHANDRA BOSE said that all efforts to deal with plague in Calcutta had failed, and he strongly advocated the introduction of a Compulsory Notification of Diseases' Act into that city.

DR. DE MELLO explained in detail the measures taken in Portuguese India during the epidemic of 1910. He concluded that evacuation, if necessary by force, was a measure of incalculable value.

COLONEL BROWNING SMITH endorsed Major Glen Liston's remarks as to the defective nature of the registration of vital statistics now in force. He said that in the country round Delhi during the Durbar of 1911 the offering of a reward for information of dead rats was extremely successful.

MAJOR SOUTHON thought that the reason that towns in the Punjab had suffered relatively less from plague than villages was due to the fact that the food supply stored in the houses of the latter was relatively much greater than in those in towns. Rats were also relatively far more abundant in villages than in towns.

CAPTAIN KUNHARDT in replying reiterated that his remarks and observations only applied to the Poona and adjacent districts. He said that the quiescent season in the Poona district was much shorter than in the Punjab, and that the seasonal prevalence of the disease in the two places was markedly different. These facts probably accounted for the divergent opinions on the subject. He said that the severity of plague is each year diminishing in India, and that as years go by measures such as he advocates will become easier. He referred to some parts of India where there was never, properly speaking, an off-season. With reference to Major Glen Liston's criticism that plague returns were so defective, he thought that his second paper had demonstrated that they were sufficiently accurate for the purpose he had in view. Of course, if methods of registration could be improved the work would be infinitely easier.

LT.-COL. BROWNING SMITH introduced his paper on "Rat destruction and plague," and said:—Operations in our fight against plague may be divided into two classes more or less distinct.

In the first class we have operations having for their object the direct prevention of our annual plague epidemics, the attack on those places which carry infection over the off-season, and, where this fails, the attempt to stop the spread of epidemics which have just begun. In the second class, operations for relief and mitigation of epidemics which are in full blast and beyond control.

Of these, measures of the first class are much the more important, for the more successful they are, the less we require the second; for these more important operations there is only one measure that we can apply immediately and generally—that measure is rat destruction. Evacuation and inoculation, valuable as they are for saving life, can never be generally applied in the absence of plague or when the disease is slight, because, in the Punjab at any rate, the people will not accept them, they are measures of the second class. To limit our measures to evacuation and inoculation would be much the same as to limit our malaria prevention campaign to the distribution of quinine during epidemics. If this argument is sound, rat destruction ranks as the most important plague measure we have, and it is for this reason that I have ventured to bring the subject before the Conference. It is, I may say in passing, also the reason why rat destruction has taken such an important place in our campaign in the Punjab.

As regards method, we have tried several viruses said to produce a fatal epizootic and they have failed; the killing of individual rats that have eaten the virus is all that was accomplished. We have carried out a small experiment on the lines suggested by Rodier and referred to by Sir Pardey Lukis in his address, the catching of rats, killing all the females and releasing the males; this was done for eighteen months continuously in two places, and I may say that a greater reduction could have been effected in a single day by rat poisoning. Rodier himself, I believe, suggests continuing for four or five years. We have no time to spend five years over the business, our attack must be immediate and rapid if we wish to prevent an active infection spreading, and the most rapid way of producing a marked reduction in the number of rats is by poisoning. The effect, however, passes off and the operations have to be repeated every two months or so. A great deal can also be accomplished by trapping; though the reduction is less rapid, it is continuous, and reductions can be maintained by this means. Another method, of injecting sulphur and other fumes into the rat holes, was introduced to the notice of delegates at the last Conference by Major Southon; it is very thorough and it appears that recovery is slow; it has however certain drawbacks which limit its application.

I am, therefore, of opinion that the best way of preventing an active infection from spreading is to lay poison in the surrounding area as

quickly as possible, and then to trap to still further reduce the numbers of rats and maintain that reduction as long as danger exists. In the area round Delhi before the Royal Durbar, such measures were applied in fourteen villages where rat mortality had appeared, no epidemic followed any of these cases.

I do not wish it to be understood that I am advocating general rat destruction over large areas with the object of rendering those areas immune; we have tried this on a very large scale in the Punjab; the results were favourable, but it was impossible to maintain the operations on such a scale.

I consider that all towns in danger of plague should be prepared to act immediately on the lines I have outlined, and that arrangements should be made to carry out similar operations in villages.

MAJOR W. GLEN LISTON then introduced the paper on "The use and advantages of Hydrocyanic Acid gas as a disinfectant for plague-infected houses and ships"* by himself, Captain W. D. H. STEVENSON, I.M.S.; and Captain J. TAYLOR, I.M.S.

In this paper comment is first made on the haphazard manner in which disinfection is sometimes practised. In many cases disinfection has become a ritual of white-washing, spraying disinfectants on floors and walls, and applying deodorants to mask bad smells, methods which can often have little effect on the germs it is desired to kill. Attention is drawn to the competition between saprophytic and pathogenic germs which goes on continuously and everywhere in nature. The devitalising effect of desiccation on non-sporing-bearing bacteria such as the plague bacillus is also alluded to. These agencies bring about the rapid destruction of most pathogenic organisms after they pass out of the animal body or after the death of the animal. For this reason methods of disinfection which are not directed against the disease-producing organisms in the special situations where they are able to persist, are wasteful and ineffectual.

The Plague Research Commission has shown that bubonic plague is maintained by the transference of the bacilli from rat to fleas and from fleas to rats. The plague germs are protected in the living bodies of these creatures from the destructive effects of desiccation and the competition of saprophytes. The essential point therefore to be aimed at in plague disinfection is the destruction of rats and rat fleas; if these are killed the plague germs will be easily and effectively destroyed by the natural processes referred to above.

The present methods of combating plague are based on this finding. Rats are caught or destroyed by poison; fleas are killed by the use of oily emulsions. But these methods are crude and imperfect. A poison is required which will kill rats and fleas alike. It should be of such a nature as to reach the rats and fleas in the inaccessible places where they are often found. Many gases have been tested for this purpose at the Bombay Bacteriological Laboratory, and it is found that Hydrocyanic Acid gas has many advantages over the others.

The authors believe that Hydrocyanic Acid gas is an efficient disinfectant for plague not because it has any lethal action on the plague bacillus, but because it kills rats and fleas which harbour the germs. The fact that rats do not generally live in grain bags but in the spaces between them, when piled in a godown or hold, and that fleas do not bury themselves in grain to a greater depth than the gas can penetrate ensures the efficiency of fumigation by this gas. The gas is easily generated, distributed and diffused through rooms, godowns and the holds of ships by the apparatus devised. Experience shows that although extremely poisonous, this gas can be used with safety by persons who exercise a moderate amount of caution, owing to its characteristic odour and the existence of a simple and delicate test for its detection. The gas does not injure the most delicate fabrics or metals

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and does not render food unfit for consumption ; grain *will* germinate after exposure to the gas. No light or heat is required for its generation so that the danger of fire does not arise. The cost of chemicals for generating the gas is small and the apparatus used for the purpose can be made fairly portable. Hydrocyanic Acid gas being slightly lighter than air can be easily removed from holds, rooms, etc., by ordinary ventilation. Experiments (carried out by the authors, which are detailed in the paper) show that the quantity of gas required for efficient disinfection will depend on the air-tightness of the room, the time for which the gas is allowed to act, the thoroughness of the distribution and diffusion of the gas, as well as on the cubic capacity of the room, and whether it is full or empty.

In general one-half to three-quarters of an ounce of potassium cyanide per one hundred cubic feet will be required for generating sufficient gas to secure the destruction of fleas and rats, and the gas should be allowed to act for about four hours before being removed.

The comparative merits of Hydrocyanic Acid gas, Sulphur dioxide and Carbon monoxide for plague disinfection are given in tabular form. Hydrocyanic Acid Gas appears to be superior to the others in every way.

	Hydrocyanic Acid (HCN)	Sulphur Dioxide (SO_2).	Carbon Monoxide (CO).
Effect on rats	Very lethal in small concentration(·15%), after short exposure.	Lethal in strong concentration 4% after a more prolonged exposure.	Lethal especially at lower level of room.
Effect on fleas	Ditto.	Lethal only on prolonged exposure to strong concentration. Effect less than on rats.	No action on fleas.
Effect on grain ...	Does not prevent germination or render poisonous.	Spoils grain. Prevents germination.	No effect on grain.
Effect on metals and fabrics.	No destructive action.	Spoils metal. Bleaches cloth.	No destructive action.
Cost of chemicals only per 1,000 cub. feet to be disinfected.	Six annas ..	Rs. 6-8-0	Two annas.
Dangers	(*a*) Highly poisonous to man but on account of lightness easily got rid of from the holds of ships. Detectable by smell which gives warning; also by delicate chemical tests.	(*a*) Irritant. Smell gives warning and no one is likely to remain in atmosphere containing strong concentration long enough to be seriously affected.	(*a*) Poisonous, remains at lowest levels and difficult to blow out. No indication by smell.
	(*b*) No danger from fire	(*b*) Fire required to produce gas. Gas is also capable of setting fire to ship from its action on Refrigerating apparatus.	(*b*) Fire required in production, no other fire danger.
Special advantages ...	Cheapness. Efficiency on both rats or fleas. Rapid action. Generation of gas easily controlled.	Less poisonous ...	Cheapness.
Special disadvantages ...	Poisonous effect ...	Danger from fire. Destructive action on certain cargoes.	No effect on fleas. Poisonous effect on man. Not detectable by smell.

SIR PARDEY LUKIS :—Before the discussion on these papers commences, I just want to make a statement as to certain things we have been doing recently. Sir Harcourt Butler, in his introductory address, drew your attention to the importance of disinfection of ships in connection with the spread of plague and its introduction into Java, Manila, and the Straits Settlements, but you must remember that the question of disinfection of ships is one which we have to consider now, not only in connection with plague, but also in connection with the possible importation of yellow fever into India. Therefore last summer, at the

expense of the Research Fund, we deputed Dr. Hossack, the Port Health Officer of Calcutta, to visit the various European ports with reference to existing quarantine and sanitary arrangements, and the measures proposed against the introduction of yellow fever into India. He toured for about two months visiting Genoa, Havre, Amsterdam and a large number of other places, and when I was in Calcutta early in January he showed me the notes of the report which he has now prepared, and which he is going to submit to us very shortly. This report he has divided up under six heads—(1) The general trend of opinion as regards quarantine and other methods for the prevention of the importation of disease by sea ; (2) The limitations and shortcomings of the Clayton process of fumigation by Sulphur dioxide, the advantages and disadvantages of rival methods, and the possibility of applying other gases than those generally used ; (3) Methods of inspection of food imports ; (4) Proposal for the establishment of a sanitary station at Diamond Harbour specially fitted to deal with yellow fever infected ships ; (5) Regulations as regards construction of ships ; (6) The advisability of changes in the administration of maritime sanitary services. As regards the second head, all I need mention is that he has dealt at considerable length with the disadvantages and limitations of the Clayton and most other processes, and that everything he says strongly supports the views of Major Glen Liston as set forth in the paper under discussion.

MAJOR MARJORIBANKS :— I think I may claim a very special interest in Major Liston's paper, having myself had to undertake a good deal of de-ratisation of ships with Sulpher dioxide by the Clayton process, when acting at different times as Port Health Officer, Bombay. Major Liston has enumerated the disadvantages of that gas. To these I may add what one may call the personal disadvantage. To spend the day on a barge, looking after a furnace which turns out SO_2 from some 11 cwt. of sulphur, is a trying enough thing for a man in perfect health. For anyone who has a cold, or is subject to bronchitis or asthma, it is simply torment. I have known a single breath of the gas, as it came up from the newly-opened hatchways of a ship, convert an ordinary cold into acute laryngitis.

This is why we want a substitute for those dreadfulsulphurous fumes.

I understand that the experiments so far carried out by Major Liston have been financed by the Central Research Association, and that they have only come to a stop with the exhaustion of the grant.

What is wanted is that an apparatus should be constructed which will enable the holds of ships to be fumigated with the gas, so as to test it under service conditions.

The main point to be decided is whether there is any danger, that lascars may be apt to enter a hold before it has been properly ventilated, or whether the HCN gas makes its presence sufficiently felt to warn off even the most ignorant person who has never smelt prussic acid before.

In connection with this we must remember that holds of ships are only ventilated from above, except sometimes through water-tight doors in bulkheads.

It has also to be remembered that there are places which must be de-ratised which are still more difficult to ventilate than holds. There is the lascars' store-room in the after-part of the vessel, and the marine store-room in the fore-part. This latter is very difficult to ventilate, consisting, as it does, of a series of small compartments on the top of one another, communicating by means of small hatchways just wide enough for a man to pass through, right down to the keel of the ship. Windsails cannot be fitted to such places, and it would need an exhaust tube to ventilate them properly.

The other point to be worked at is the perfecting of the machinery, to bring it to a point where, if the gas proves satisfactory, it will pay a British firm of manufacturing engineers to put it on the market. It

has to be borne in mind that that market is already occupied by firms, British and American, who provide machines for the evolution of sulphur dioxide gas, and there will be formidable rivals.

In this connection I would propose that the Mechanical Engineer to the Government of Bombay should be deputed to collaborate with Major Liston and the Port Health Officer.

This is not a mere case of starting on a new line of research which may or may not lead to something, it is a case of finishing up a piece of work which has yielded most hopeful results. I hope that a further and liberal grant from the Central Research Fund may be given to Major Liston.

LIEUT.-COL. DRAKE-BROCKMAN said: I feel sure that all of us who a few days ago were privileged to see at work Major Liston's apparatus for the destruction of rats and their fleas by Hydrocyanic Acid gas and the satisfactory results achieved, must welcome the process as one likely to be extremely useful in the solution of a very difficult sanitary problem. He and his colleagues are certainly to be congratulated upon the results. There are, however, one or two very important points to be considered before its general application is adopted. There are the chances of accidents owing to the extremely lethal character of the agent used, and it is important that the apparatus, as it stands, should not perhaps be allowed to be operated except by responsible and skilled hands. The process is, of course, eminently adapted for the disinfection of ships, but even here I consider that the same difficulty may arise. In looking at the apparatus working it will be seen that there is only one exhaust pipe through which air is sucked out of the space in which it operates. The air then passes through the gas chamber, and finally is forced again back with more gas mixture into the room through many smaller pipes. Now in the case of a ship's hold, for instance, it may be necessary to take the gas down into the very bottom of the ship, for it must be anticipated that rats, directly the gas comes into contact with them, will migrate to all parts of the ship's interior, down possibly to the very keel. It is this point I wish to emphasize; in such conditions how can the gas be effectually removed so as to ensure the safety of those going on board afterwards and into such places? Colonel Drake-Brockman then mentioned the apparatus devised by Leonard Hill, and continued: I can assure the originators of this most ingenious apparatus that I do not in any way wish to discourage its adoption, but on the contrary to suggest that, in addition to what is already done, some satisfactory arrangement may be made—chemically or otherwise—to neutralise, and at the same time render innocuous the lethal gas evolved, after it has done its work of destruction, so that all possible chances of accident or risk to human life are eliminated therefrom. I feel sure that such cannot be outside the domain of possibility of the skilled chemist, as ammonia and possibly other agents could, without much difficulty, be utilized to effect this desirable end. I hope the originators will give this matter their attention, as I feel sure, if successful, that the sphere of utility of their ingenious apparatus will be very materially increased thereby.

MAJOR SOUTHON said he thought that the method would be extremely useful for big godowns and ships, but for villages it would be only of limited applicability owing to the cost, weight, and complicated nature of the apparatus, and the necessity for skilled supervisors. In operating in a village which is infected, one would like an apparatus of a smaller size for use in houses and rooms known to be plague infected. The time necessary to disinfect a house in this manner was also a drawback, but he hoped the ingenuity of the inventors would produce a very much smaller and less costly apparatus. He agreed with Colonel Browning Smith as to the practicability of destroying rats by means of poisoned baits and trapping. These methods were quite efficient, but unfortunately they had some drawbacks. These were, firstly, that in

both these methods, you have to get the co-operation both of the occupier of the house and of the rat. The occupier to take the baits or traps, keep them clean, and bait them; the rat has the option of entering the trap and he soon learns that it is a trap, he has the option of eating the bait and very often avoids it. Major Southon then enumerated the advantages of the smoke stove which he had found successful in the Punjab. It was simple, cheap and effective. It was non-poisonous and no dead rats were left behind to give rise to offensive smells because in employing the stove in the rat hole both the exits and the entrances were caked over with mud. It could be done very quickly and it was not necessary to repeat the process more than once a year. Its disadvantages however were the necessity for conscientious supervision, for clearing houses before carrying it out, and the fact that rats not living in holes escape.

Captain Cameron thought that any system of rat destruction had drawbacks unless one could secure the co-operation of the people. He thought that Major Liston's method would never be applicable in villages. The great drawback was the time occupied, which would make simultaneous rat destruction impossible in any district where there was a considerable amount of plague. Again in the United Provinces the season during which they would require to attack the villages corresponds to the rainy season, when large areas of the country are under water and such a heavy and complicated apparatus could not be carried about. Another difficulty was that the rat holes would not be blocked up after the application of this method, this would lead to offensive smells, and as a natural consequence opposition from the inhabitants of the remaining houses. He had tried the smoke stove method in the United Provinces, in villages where infection was reported or suspected during the recent "off-season," but had not had satisfactory results. He attributed his failure to the religious prejudice against rat destruction and to the apathy that prevailed throughout the province, and the impatience of interference exhibited by villagers in what they considered their private concerns. Rat-trapping or poisoning, in an equal degree required the sympathy of villagers. He believed that the Indian would work out his own salvation in this matter if he could only be convinced of the dangers of living in close association with rats. The main policy in the United Provinces is the system of travelling dispensaries described by Captain Ross last year.

Captain Kunhardt:—Colonel Browning Smith's opinion based on his experience of rat destruction in the Punjab is most encouraging. I feel sure that if similar results could be obtained in Poona a great deal of good could be done by rat destruction in the off-season at a smaller cost than I had anticipated. He mentions that poisoning together with trapping is a good method of keeping down the rat population. I should like to have his opinion as to what he would consider the best method for obtaining a maximum temporary reduction in the rat population of an average village in the minimum space of time. Does he consider that rat poisoning without trapping would be sufficient? It would reduce the expense of prophylactic measure such as I have suggested to an enormous extent. In regard to Major Glen Liston's paper, I would like to suggest that the very valuable disinfectant mentioned therein might be tried in some of the kala-azar houses that Colonel Rogers spoke about yesterday; it might be of more use than sulphur dioxide.

Major Glen Liston:—I should like to thank those gentlemen who have spoken, for their kind suggestions, especially Lt.-Col. Drake-Brockman and Major Marjoribanks. We shall endeavour as far as possible to improve our apparatus with the assistance of their suggestions.

Colonel Browning Smith:—I only wish to say that I should not advise poisoning alone because, as I have said, the effect is quite

temporary and lasts perhaps a couple of months. If you have plague infection in a village and you start a poisoning campaign, it does not follow that you have absolutely eradicated that infection; you have of course prevented it becoming epidemic because you have killed off a large number of rats; in time the rats will increase and so I cannot recommend rat poisoning alone unless it is fairly frequently repeated. I would strongly recommend that traps should be used in addition to poisoning: you first lay the poison baits, that produces a sudden and immediate reduction of the rat population, and then you use traps steadily, thus producing a still further reduction and maintaining that reduction.

SECTION A.

SECOND SESSION.

THE HON'BLE MAJOR J. C. ROBERTSON, C.I.E., I.M.S., PRESIDING.

Vital Statistics.

DR. BENTLEY introduced his paper "Note on some points of interest regarding vital statistics," of which the following is a summary :—

The paper calls attention to the general neglect of the study of vital statistics in India. The accuracy of existing records in Bengal are discussed, it being pointed out that there is little to support the view sometimes expressed that registration is approximately accurate. A very large number of towns in Bengal record death and birth-rates which are obviously much too low. Investigation in certain towns has shown the proportion of omissions to range from 31 per cent. to as high as 78 per cent. In rural areas registration is equally defective. As many as 30 per cent. of the deaths and 52 per cent. of births have been found unrecorded, and there are reasons for supposing that at least one-fourth or one-fifth of the births are generally unregistered. The village chowkidar who is responsible for recording vital occurrences in rural districts is careless and inefficient; and if, on the average, each man omits to report only one birth or one death, the respective birth and death-rates of the province would be 2 per 1,000 below the actual. If we compare a curve showing the mean recorded mortality rate of the last 5 years for each district in Bengal, with another curve showing the proportion of village chowkidars per 10,000 of the population, a remarkable correspondence will be observed. The proportion of chowkidars in different districts varies from 13·9 to 28·2 per 10,000. Districts with relatively few chowkidars always record low mortalities and districts with many, high mortalities.

Turning to other problems, the question of the relative fecundity of Indian races is touched upon, and it is pointed out that the records show that in Bengal districts the recorded births vary from 182 per 1,000 married women aged 15—40 to as high as 267. Recorded birth-rates also vary enormously. In some areas they reach over 50 per 1,000 of the population. Unfortunately we have no exact knowledge regarding the normal birth-rates of Indian communities.

Infant mortality is then alluded to, and it is shown that the figures recorded for Bengal districts exhibit remarkable variations. The result of some investigation into the age of infants dying is given, apparently two-thirds of infant deaths take place during the first month of life and about one-third with the first 24 hours after birth. The conclusion of the paper refers to the unsatisfactory method of recording causes of deaths, especially the abuse of the term "fever," and urges that the existing procedure should be modified in view of the constant misapprehension to which it gives rise.

DR. BENTLEY said :—The first paper that I have to place before you to-day is really written in order to try and attract some little attention to a branch of research which appears to have been largely overlooked in the past. In India the only certain thing we know about vital statistics at present is that they are highly inaccurate. They are more inaccurate in some areas than in others. We do

not know the extent of their inaccuracy; and vital statistics being so uncertain, it becomes almost impossible to draw conclusions in regard to such points as the fecundity of Indian races, infant mortality, and a number of interesting facts of that kind. We can only guess. As regards the birth-rate per thousand married women aged 15 to 40 during 1912 there are such extraordinary variations, as from 83 births in the Burdwan district, to something like 267 in the Murshidabad district. The fecundity rate per thousand women aged 15 to 45 in Scotland a few years ago was 260. In India it should be higher because we are only dealing with the ages from 15 to 40. As a matter of fact, there are a very much larger proportion of married women of those ages to the female population in India than in Scotland, which suggests that the birth-rate is very much lower, when as a matter of fact we know it is very much higher. That is an indication of fallacy, and the very fact that there are these tremendous variations in adjoining districts such as we see here in Bengal is pretty good evidence that there must be some very great uncertainty in regard to recording of our statistics.

Take again the case of infant mortality which is now-a-days, I think, of extreme importance. We see here a tremendous variation between different districts. In some there are only 156 per thousand births, while in others the figures go up to 259 and 286. Are those variations facts or are they mere fallacies? Another point of importance that I found on investigation was that in a number of districts in Bengal, of the total infantile mortality, one-third of it takes place within the first 24 hours of birth, and practically another one-third takes place before the expiry of the first month. The result is that two-thirds of the total infantile mortality occurs within the first month of life. I think that is rather an important observation. It shows very well that, if we exclude such diseases as say tetanus, it must probably be due to weakness or malnutrition on the part of the mothers in a great number of cases, and it points to the fact that we must, while directing our efforts to the improvement of the conditions of infant life, also pay great attention to the condition of mothers during pregnancy.

There is another point I would like to draw your attention to before I go on to the other paper. On the diagram which I have given you will see that, taking all the districts throughout the Province, a certain number show consistently high mortality and others a consistently lower mortality. Now it has often been supposed that this is due to the relative healthiness of the different areas, but when I came to enquire into the methods of registration, I discovered that the number of chowkidars who are responsible for recording vital statistics per thousand of the population differ enormously in different districts, and I have put the results down in this table which shows that where there are a large number of chowkidars per thousand of the population, you get a large number of vital occurrences recorded, and where there are only a few, you get a smaller number. Therefore, in saying that one district is healthier than another we may be making a mistake; it may be the other way about. As showing the difference in the number of chowkidars, I might mention that 20 years ago in the Burdwan district there were 16,000 chowkidars which was one chowkidar per hundred of the population. There are now only 3,400. I do not know how far the Burdwan district is now healthier or is supposed to be healthier than it was 20 years ago. All I know is that there is a considerable amount of error in the registration even at the present time.

In my second paper, "Note on some simple methods of testing the registration of vital occurrences in India,"* I have suggested a few simple methods which I think may be applied in many parts of India for really finding out what the inaccuracy in recording births

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is, and also for getting an idea of the inaccuracy of death returns. It is a very simple matter to test the birth-rate. We have our village records, a book in which all the births are recorded, and a book in which all the deaths are recorded. We need only take a period of say 13 months, and let a clerk make out two tables, one of all the births, giving names of parents, date, etc., and one of deaths of infants, and then it is simply a matter of taking all the infant deaths that occurred in the last month in the period and finding out how many of their births had been recorded during the previous 12 months. By doing this in a considerble number of cases we can get a very fair idea of the percentage of births omitted. As you will see from my paper, in the Galsi thana of the Burdwan district, in which investigations had been undertaken at the suggestion of the late Colonel Leslie, and in which they imagined that they had got almost absolute accuracy, I discovered that the actual error in registration of births was something like 21 per cent. I may mention that it is necessary in the case of Bengal, and perhaps in other areas, to make a slight correction in the figures first taken. To do this we have to find out what proportion of births have taken place away from the father's house and a child may be born in one village and die in another.

The other suggestion that I make is that sub-inspectors of vaccination, who are often supposed to go out and verify the recording of vital statistics, should be encouraged to do this work more systematically. At the present time they are simply told to go out and check the chowkidars' returns. If the man works honestly and discovers a large number of omissions these are reported to the Civil Surgeon, the Civil Surgeon reports the matter to the Sanitary Department, the Sanitary Department writes a letter to the Collector of the District asking that steps be taken to improve registration, the Collector drops upon the District Superintendent of Police and says his sub-inspectors are not looking after the chowkidars; the sub-inspectors drop on the chowkidars and the chowkidars go out and make it very uncomfortable for the vaccinators and sub-inspectors of vaccination. The result is that there is an apparent improvement. But it is not an actual improvement. It is simply due to the fact that the man who has caused the trouble finds that he has got into hot water; he gets no great encouragement to continue, and so he stops making a fuss and the omissions apparently decrease. I think, instead of giving inspectors of vaccination orders to bother their heads about vital statistics, we might employ them indirectly and say "here are a thousand children born a year ago, find out how many have been vaccinated, how many of them are dead and how many living." Then when we get their figures we can compare them with our own records, and the result will give a very fair idea of the number of deaths of infants that have been omitted; and when we get the percentage of omissions among infant deaths, I think we may safely conclude that the percentage of omissions among adults is about the same.

CAPTAIN MCCOMBIE YOUNG in introducing his paper on the "Registration of Vital Statistics"* said:—My paper suggests that, as better class persons in Bengal and Assam appear to object to reporting family occurrences such as births or deaths to a police constable or low class registrar, an improvement in the registration of vital statistics in towns may be effected by putting the work in the hands of a better class registrar of the status of a sanitary inspector or health officer, and by introducing a system of granting official certificates which should be accepted as legal evidence of birth and death, a change which modern conditions of Indian social life renders desirable.

It is suggested that such changes would produce a more favourable attitude towards registration on the part of the better educated and influential classes, an attitude which would find its reflection in the

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community at large and would aid us towards obtaining a higher standard of accuracy in registration than at present exists. I therefore suggest that Major Robertson's proposals to appoint medical registrars of the grade of sub-assistant surgeons should be adopted, and that authenticated copies of entries from an official register should be given a legal status and accepted as evidence of birth or death.

A "Note on the Registration of Vital Statistics in Sind,"* by Major W. Murphy, I.M.S., was taken as read.

DR. SHROFF:—Major Murphy in his paper states that what is needed in Karachi is reliable information as regards cause of death. As I represent Karachi, I should like to say a few words on the point. I quite agree with Major Murphy that the registration of the cause of death in Karachi is defective to a certain extent. The defect is due to the fact that many deceased, I would say as much as 50 per cent. or perhaps more, are never attended by duly qualified medical men during their illness. These are mostly the poorer class of people who generally prefer their own domestic treatment, or at the most would go to a quack instead of taking advantage of municipal charitable dispensaries. I am of opinion that if nurses in the form of health visitors were employed, as is desired in cases of tuberculosis, I am certain a good deal of improvement would result.

DR. WANLESS said it seemed to him that one of the main causes of fallacy in collecting vital statistics was the fact that the chowkidar was made the diagnostician of the disease. He knew this was done all over the country. If some simple plan could be adopted by which the chowkidar could secure entries in answer to a few simple questions with reference to plague, tuberculosis, etc., and if these answers were subsequently submitted to a medical officer, possibly to the sub-assistant surgeon, if he were deputed as the registrar of vital statistics, he could tell in the great majority of cases what was the cause of death. In this way the cause of death could be determined approximately in regard to a certain number of diseases, at any rate.

DR. NEWELL:—There is no doubt about the imperfect registration of births and deaths and that the statistics generally are inaccurate. The last speaker referred to a proposal which is actually being carried out in Lahore. I have certain forms with about 26 questions to be filled up, printed in green for Muhammadans, and white for Hindus. The chowkidar at the burial-grounds gets these forms filled in by the relatives of the deceased. These forms are filled in, in duplicate; the relatives of the deceased are given one copy which is taken directly to the registration office in the mohalla where the death happens to have occurred. The other one is sent direct to my office. I send this to my sanitary inspectors, two of whom are medically qualified, and the third is a European. We enquire into all deaths which are registered as due to infectious diseases, including tuberculosis, and infant deaths are enquired into through the medium of our midwife. By these methods we find that a large number of deaths which are recorded as due to "fevers" are really due to many definite diseases. These answers are further enquired into by the sanitary inspectors and returned to my office and the final diagnosis is decided on by me.

Another point of importance is that the European deaths are not accurately reported. I found nearly 50 per cent. of European deaths were not recorded at all in the registration offices, and even now there is a large percentage of European deaths which are not correctly returned. People go to the cemeteries and they think the registration is complete by simply filling in the book at the cemetery.

With regard to the suggestion that vaccinators should be given this work of death registration, I think that if the vaccinators are able to do this extra work it would appear that there are too many in that area. I think I am right in saying that the Superintendent of Vaccination is

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supposed to go round periodically and enquire into the correct registration of births.

The suggestion of a medical registrar, I think, is one that this Conference should insist upon. Registrars of deaths and births should be medically qualified, and through their agency we would be able to enquire further into the causes of deaths.

THE HON. MR. RAMACHANDRA RAO pointed out in regard to what Capt. McCombie Young had said as to authenticated copies of entries from official register being given a legal status and accepted as evidence of death, that the Municipal Acts in Madras already provided for the grant of certificates from registrars, and these were regarded as evidence of death. He thought some such provision should be introduced in Assam if it did not exist.

The question of the registration of vital statistics had to be considered from the point of view of urban areas as well as of rural areas. In urban areas there was a machinery for recording deaths. Most of the municipalities in Madras had poorly paid establishments for this purpose who had no exact knowledge as to causes of deaths and had to rely on the relatives of deceased persons. A better staff should be engaged who had medical knowledge. From this point of view he welcomed Major Robertson's proposal for the appointment of sub-assistant surgeons as registrars. Municipalities needed financial help to enable them to engage better staffs than at present.

In regard to rural areas in Madras there was an Act which required registration of vital statistics, but it had been made compulsory only in certain selected localities, and even there the registration was carried out by village officers who had not sufficient information to correctly diagnose and classify the causes of deaths. The present system both in urban and rural areas was unsatisfactory.

DR. B. B. BRAHMACHARI :—In my paper on vital statistics read before the last year's Conference I had the honour to make some suggestions for the improvement of registration of deaths. I may be permitted to repeat them :—

(1) For quantitative improvement, *i.e.*, to insure entries of all deaths in the register, I suggested (*a*) that in municipal towns the work might be transferred from the police to the municipalities ; (*b*) that disposal of bodies might be restricted to places provided for the purpose and that at all such places there should be clerks, *i.e.*, sub-registrars, who should make entries of the particulars of deaths in the registers kept by them, and should send daily extracts of the entries of the preceding day to the registrar for information ; (*c*) that private places of disposal should be licensed on condition that every disposal in them should be promptly reported to the registrar on pain of heavy penalty in default.

(2) For qualitative improvements especially to insure that deaths are entered under the actual causes, I suggested (*a*) that names of causes in the register should be more definite. Instead of fever, there should be two columns, one for malarial fevers and the other for typhoid fevers. The dysentery column should not include diarrhœa from other causes as "dysentery and diarrhœa." It should be headed "dysentery." Tuberculosis should have a column by itself instead of being mixed with respiratory diseases. (*b*) That causes of all deaths entered by the registrar should be promptly investigated. In municipal towns this may be done by the health officer or his qualified assistants. In villages the registrars may get the help of qualified medical practitioners on payment of a reasonable fee.

DR. K. C. BOSE thought it was a deplorable fact that the registration of births and deaths was so inaccurate. India was very much behind countries of the West. Even the educated classes did not register births. Correct vital statistics were the foundation of sanitary science and the only way to obtain these he thought was to enforce the certification of births and deaths as suggested by Capt. Young in his paper. He also thought that the *dais* whose number was very large, should be compelled to sign a bond to report every case of birth that came to their knowledge. He supported Major Robertson's scheme for the appointment of sub-assistant surgeons as registrars.

DR. TURNER said he would not trouble the Conference with an elaborate account of the system in force in Bombay Island, as the paper they were discussing referred more to the difficulties in rural areas. He did not think registration should present a great difficulty in large towns. About 11 years ago he had met the Health Officer of Calcutta, the late Sanitary Commissioner with the Government of India, and a representative from Rangoon, and they had discussed this question of vital statistics so far as it related to large towns, and had drawn up the forms which were still contained in the annual health reports of those cities. He suggested that now the Government of India had taken up the question of sanitation in earnest, and were appointing health officers in all parts of India, the first duty of a health officer should be to see that his statistics are as accurate as he can make them. Nothing was more important to the health officer than correct statistics. He would like to suggest that, if there was a resolution on this subject it should be to the effect that Local Governments should in all areas, large or small, urban or rural, insist upon the health officer drawing up a scheme for the improvement of the vital statistics in his district.

MAJOR C. H. BUCK :—In my part of the Punjab I recently discovered that there is an area outside municipal limits, but within the revenue village area, in which a municipality is situate, where no vital statistics are recorded. Also sometimes in a civil station there is no record except for Europeans. That is, in those areas where there are no village chowkidars or municipal committee responsible, there is sometimes no record. As this may be the case in other parts of India, I think it desirable to bring it to notice.

THE HON'BLE MR. DONALD :—The Eastern Bengal system has changed since Captain Young was transferred. We recently discussed the whole question in Bengal and decided to relieve the police of the duty of registration in urban areas. We have imposed this work on the municipal commissioners and suggested to them the employment of health officers and sanitary inspectors as registrars. In rural areas we hope to effect improvement with the institution of union committees, and the extension of the system of circle officers, if carried out, will also tend to an improvement in the record of vital statistics.

DR. SOUSA :—In Lucknow the registration of deaths among Christians is very defective. In the last annual report the deaths among Christians were *nil* and the Municipality passed a bye-law that clergymen should be made responsible for reporting such deaths.

In Lucknow we have a double agency as recommended by the United Provinces Government. One is that reports come through jamadars and sanitary inspectors ; the other is by special moharrirs. We have divided Lucknow into 22 circles and one moharrir is appointed for each circle. We have two hospital assistants to supervise their work. The health officer is the mortuary registrar.

MR. FORREST referred to the illiteracy of chowkidars especially in rural areas and thought it was impossible for them to ask elaborate questions and report the answers to the thanadar.

DR. BENTLEY pointed out, in reference to Dr. Newell's remarks, that in the off-season sub-inspectors of vaccination were sent to verify

the recording of vital statistics by the chowkidars, and he had simply suggested a simple method of making use of their services.

He added that he wished to support what Captain McCombie Young had said in regard to the importance of registration in towns. He thought the suggestion that a medical man should be allowed to grant certificates of death would meet the case in towns. Many educated people in Bengal actually avoided registering the births of their children. He knew of a case in Shillong where an educated man refused to register his child's birth because his female relations were afraid that something dire might happen if he did so.

From his investigations in Bengal he was convinced that they could get better returns than at present if they did not bind the returning officers down by a hard-and-fast schedule. As a matter of fact, chowkidars and the village people themselves would return all sorts of different causes of death if they were given the chance. The bulk of them recognised phthisis and differentiated malarial fever from other fevers. They had their own names for such things as measles and phthisis and pneumonia, though the names differed in different districts. It was because there was the one column labelled "fever" that all febrile diseases were entered under it.

He agreed with what had been said in regard to the illiteracy of chowkidars, but thought, if they did not theorise too much, it would still be possible to make use of their help.

CAPTAIN MCCOMBIE YOUNG then referred to Mr. Donald's remarks in regard to entrusting the collection of vital statistics to municipalities. He doubted the wisdom of this course because there were all kinds of municipalities. Energetically conducted municipalities would perhaps give reliable returns, but there were many others who probably would not. He thought the collection of vital statistics should be a separate Government Department and should not depend on the municipality in any way.

SECTION B.

Mr. W. Hutton, Presiding.

(*a*) *The use of cast iron, steel, and ferro-concrete pipes for water-supply and drainage systems.*

The President :—Mr. Montgomery wishes me to pass round some samples of grease and sewage sludge. Also a sample of crude grease and a sample of refined grease, in connection with Dr. Grossmann's process of extraction of grease from sewage sludge mentioned in the paper by Mr. Aikman.

Before we begin the first paper, Mr. Montgomery wishes to add a few remarks to his paper on tube-wells, in connection with further information which has come to hand.

Mr. Montgomery :—Immediately on returning to my house after making my remarks on tube-wells, I found a letter from Mr. Brownlie, the inventor of the tube-well, in which he complained of some mis-statements made in the original paper. The gist of it was three points, which he asked me to reconsider. The first was that the statement made in the paper, that the form of construction of what he called convoluted tubes is a weak form of construction, is incorrect, and he says that he is willing to have it settled by arbitration. As to whether it is a weak form of construction I do not wish to comment, because these two gentlemen being rivals, I do not think it is sound for me to discuss it further. I merely wish to bring it to notice.

He then objects to our statement that the round wiring when the tube is in use, is inferior to the trapezoidal section; as regards the tendency of sand to pack up in the slots, you may remember what I said was that the sand got drawn up against these round wires. In my personal assistant's opinion it was much more likely to suck up against these round wires than if it came up against these trapezoidal section wires. I still adhere to that opinion.

The third point was that in making the comparisons between the two tubes, the paper drew attention to the fact that it would be cheaper to sink an Ashford tube, as it would be possible to use a smaller bore pipe for this one than it would be for the other. I promised Mr. Brownlie that I would mention these three points.

The President then introduced a paper on "Note on a reinforced concrete pipe for Ahmednagar water-supply,"* contributed by Mr. T. S. Pipe, in which an account is given of the methods of construction and testing of a set of twenty reinforced concrete pipes in connection with the proposed rising main for the Ahmednagar water-supply.

Mr. Robertson :—I should like to say that one cause for the bad results is that the reinforcing is done by 1″ × $\frac{1}{8}$″ flat bars, and I have always found that a flat bar of that kind tends to start cracks in the concrete. If you will notice the tables 2 and 3, in the flat bar sections Mr. Pipe has got no results whatever. Where he has used round bars he has had some results.

Another point is that after 36 hours the pipes were lowered from the vertical to the horizontal position. But I think that is altogether wrong. The concrete should not be touched for a week. In fact, I always leave things of that sort for 6 weeks before handling it at all.

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I should like to say that in Darjeeling I had occasion to fit a ring of ferro-concrete to connect one of the power pipes to one of the turbines for the Darjeeling Hydro-electric plant, and this has been running for two years under a head of 275 feet without a trace of leakage. I use no special cement and no medusa or other waterproof material. Then about five years ago I laid about 100 ft. of 42-inch ferro-concrete pipe for the same plant and this pipe has been in constant use ever since under a head of about 10 ft. As for steel pipes, we have about 10 miles of them in Darjeeling, mostly supported on ferro-concrete and iron standards. They have been in use about two years and I find that there is some corrosion when they touch the ground, but none when they are supported above ground. So far we have had no corrosion on the inside of these pipes.

MR. HUTTON :—In connection with Mr. Robertson's remarks about the corrosion of steel pipes, I read a paper at Simla at the Engineering Conference in September, and I think in that paper I also stated that we found no corrosion in thin steel pipes, where these steel pipes are above ground. It is only when they are buried in the ground that corrosion seems to occur on the outside, pointing to the fact that they must be very efficiently protected compared with cast-iron pipes. You can take many more liberties with cast-iron pipes than you can with steel pipes. In India we are beginning to use steel pipes instead of the old cast iron pipes, and in Madras we found to our cost that we should have taken more precautions than we did take. We have not used any reinforced concrete pipes in Madras and I do not see any immediate prospect of using them. We have used cement pipes as Mr. Madeley will tell you, without reinforcement, for sewers, but these cement pipes proved very unsatisfactory and their use has, I think, been finally abandoned.

MR. MONTGOMERY :—On reading this paper and seeing the poor results obtained, I think it is a matter of extreme regret that Mr. Pipe is not here to ask him a few questions. I suggest that the paper should be brought up again at the next Conference for his results are entirely at variance with the practice in the rest of the engineering world. In America the use of ferro-concrete pipes is extremely common. I may say that at Simla I constructed a reinforced concrete pipe, 4 feet diameter, 5 inches thick, reinforced merely with a ring of expanded metal and some round longitudinal rods about $\frac{3}{8}$ of an inch in diameter, and it was a quarter of a mile long and under a 40 ft. head. From the day that pipe was made to the day it was brought in use there was not one trickle of water out of it at all. And with regard to what Mr. Robertson has said about his success in using reinforced concrete pipes, I do not think we can take that as at all bearing on the point at issue.

(*b*) *Statistics of consumption of water in water-works.*

MR. HUTTON next introduced Mr. West's note on "Prevention of Waste in Water Supplies"* on which there was no discussion.

(*c*) *Statistics of pumping per pump horse-power per hour.*

MAJOR OLDHAM then introduced his paper on "Comparative cost of pumping at various water-works in the Central Provinces,"* of which the following is a summary :—The paper is the outcome of the Madras Sanitary Conference in 1912, at which the engineering delegates suggested that information should be collected and tabulated, regarding the cost of pumping in connection with municipal water supplies in India..

The author collected, standardised and tabulated this information with reference to eight water-works in the Central Provinces, namely, Nagpur, Wardha, Bhandra, Hinganghat, Buldana, Harda, Raipur and Rajnandgaon.

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HE said :—I have only a very few words to say. The gist of this paper is in the tabular statement at the end, which gives the results of 12 months' working of various water-works pumping machinery. The figures for cost include fuel, small stores, minor repairs, and establishment at the pumping station. I am sorry I did not have the figures separately abstracted under these different heads. They would perhaps have been more useful for the purpose of comparison if this had been done. The first part of the paper contains a short specification of the plant at each installation, since without such information the figures of working cost would be of little or no value. The figures for the only oil engine, that at Buldana, are hardly fair to this type of plant. I should explain that the engine was erected during the year, and it worked for a few months only. Since that time the fuel expenditure has been reduced to about 1 pint per pump horse-power per hour, a reasonable figure. I need hardly say that the figures for the year's working as arrived at are very different from trial figures during the same period.

MR. MADELEY :—I am very interested in this paper of Major Oldham's which has been prepared in accordance with the resolution passed at the last Sanitary Conference, and I hope he will give us further figures next year, subdivided, as he thought would be better, into the different items. I have myself here records of sewage pumping at 7 stations. There is a good deal of variation in the types of plant and the quantity pumped. The two lowest priced and practically identical are an oil engine centrifugal pumping plant, and a triple expansion steam pumping plant. Both these installations work out at about 4 annas per pump horse-power. The most expensive plant is a steam direct acting compound engine plant, and that works out to as much as a rupee per pump horse-power, but that is far in excess of the cost at any other station. There is no other more than 8 annas, and the only plant costing as much as 8 annas per pump horse-power per hour is a non-condensing steam engine driving a centrifugal pump. These costs are considerably in excess of the cost given by Major Oldham for pumping water, and that is only what you would expect on account of trouble with the valves when pumping sewage. At the same time I think they can be improved. I should like any delegate here to suggest some method of plotting the results of the cost of pumping in some way which would be intelligible to other people. For instance, if I take the cases in which pumping is most expensive I can give a very good explanation. Take the case in which I said the cost came to nearly a rupee per pump horse-power. In that case the pumps had to pump against very much less pressure than they were designed for. And in another case where the cost seems rather high, it is due very often to the pumps not working full time. The standing charges are very nearly the same as in the case of other pumping stations where they have to work 24 hours a day. It is very difficult indeed to put these figures into some form, so that they will be of use to other people who do not know the conditions. If any delegate could tell us of some simple method it would be of great use to all of us who have to do with pumping stations, and require all the information we can get about them. I should say that I have myself divided the cost into fuel, stores, oil and waste, wages and overtime of driving staff, wages and overtime of repairing staff, and cost of materials, and supervision, and office staff. In my case these figures can be depended upon as being very close approximations to the cost per pump horse-power in ordinary conditions at the particular pumping station. In that connection I should like to ask Major Oldham how he determined his pump horse-power, how he measured the quantity pumped, and how he determined what was the pressure against which they pumped and the lift? In Madras, when I went there, I found it very difficult indeed to find out what thep umps were doing except by counting the strokes. We

can do that in the case of plunger pumps. We have a number of centrifugal pumps where we could not do it. I should say counting strokes gives us very misleading results even with plunger pumps, and it is often very difficult to determine what is the slip. The slip of sewage pump plants of the plunger type is very great—indeed, its valve is always giving trouble. Well, these figures are arrived at by measuring the quantity with a recorder which gives the flow continuously, and the pressures are measured also by means of a recording pressure gauge, and the suction lift is given by a recording instrument which gives the level of the sewage in the suction well. The pressure and the level in the suction well are both given in the same diagram, so you can very easily get at the head against which the liquid is pumped. Major Oldham very rightly says that the figures of coal consumption and duty which as the results of 12 months' working are necessarily very different from the figures which would be obtained from a trial over a short period. I think it would be valuable if Major Oldham could give us some information as to the relationship between the figures at the test trials and the figures in working for 12 months. That would enable persons who were intending to instal pumps to make some estimate of what the cost would be from the makers' guarantee as to what the pumps would do on trial. I notice that Major Oldham says that he hopes the results of experience would give him the cost of Semi-Diesel engines. We have recently installed these engines at three of the sewage small pumping stations. They have not had much work to do at present, but in the trials they have given very good results. I hope at the next Conference to give some figures with regard to them; also with reference to the Humphrey pumping plant and the other plants we have in Madras. I should like Major Oldham, from his experience in obtaining the cost of pumping plants, to inform the delegates whether he considers the headings into which I have split up the cost as suitable headings, because if he has any improvements to suggest I should like to embody them in my returns in order that we may all present our figures in a similar form. In the meantime I would suggest that should no amendments be proposed, then these headings should be adopted in order that we may all be able to compare our results.

MAJOR OLDHAM :—With regard to Mr. Madeley's questions, the pump horse-power is calculated from the quantity of water pumped, and the quantity is measured in the case of all large installations by Venturi meters. In some of the smaller installations, we have the number of revolutions of the engines only to guide us, and that of course is not a very accurate method of measurement. The head in the rising main is taken from pressure gauges, in all cases, fixed on the rising main. The gaugings are recorded several times a day, and the depth of water in the sump well is also taken several times a day and averaged out for the day, and then for the month, and so for the year. Adding these two together, the head for pumping is arrived at.

MR. SALKIELD :—It might be interesting to know whether these boilers are mechanical fed or hand fed.

MAJOR OLDHAM :—Hand fed.

MR. SALKIELD :—I mean, in any further statistics it would be advisable to have that inserted.

MR. MONTGOMERY :—(turning to Mr. Madeley.) Will you propose the headings ?

MR. MADELEY :—"I have pleasure in proposing that in preparing statements of the cost of pumping the following information should be given amongst others :—The gallons pumped per minute. The average head in feet. The pump horse-power. Then as regards cost, this should be given under the headings of :—Fuel, Stores (oil, waste, etc.), Wages of driving staff, Repairs (and renewals), including Wages and Supervision."

MR. HUTTON :—Does Mr. Madeley's proposal meet with the approval of the meeting ?

MAJOR OLDHAM :—Renewals would hardly come under the cost of maintenance charges.

MR. MONTGOMERY :—I should like to propose the exclusion of supervision and office staff. I think the reasons are pretty obvious. In the majority of small pumping stations they do not have any separate supervising staff.

MR. SALKIELD :—To give this statement further value, would it not be advisable to put in something about the calorific values of different fuels. Would it be possible to get the calorific value from the coal people ?

MR. HUTTON :—After coal has travelled several hundred miles as we get in Madras, it does not seem to me that calorific value counts.

MR. HUTTON :—There is one subject to which I wish to invite your attention. It is the feeling among the engineers at present here that any resolutions which engineers wish to bring up might be discussed now and voted on before they are handed in to Major Robertson. If any delegate has any resolution to propose he may bring it forward now.

MR. MADELEY proposed the following resolution which was read to the meeting by the Chairman.

1. That this Conference recommends the Government of India to appoint a committee to draft a Water Works and Drainage Clauses Act and also a model set of water supply and drainage bye-laws.

MAJOR BEADON :—I think it would be better to go a little further than that and have a general Municipal Act and General bye-laws drafted not merely for water-works and drainage, but for everything. It seems to me that municipalities want a lot of things besides. I referred to this especially when I was speaking at the meeting the other day and I feel sure if we can have that done there would be very much greater advance in sanitary and engineering matters.

I therefore suggest an amendment—that the proposal be expanded.

MR. HEWLETT :—Is there some difficulty, Sir ? Do not all local Governments pass their own Act ?

MAJOR BEADON :—The Imperial Legislative Council has the power of passing Acts which apply to all provinces.

MR. HEWLETT :—These provinces (U. P.) have already got a Water Works and Drainage Act.

MR. SALKIELD :—Why not call it a general Public Health Act for India ?

MR. MONTGOMERY :—May I sound a note of warning here ? It seems to me that the original proposal of Mr. Madeley was a very excellent one and that if we tack on to it anything to do with health matters or sanitation generally for municipalities and cities, we may let ourselves in very badly unless we know what is in existence and what we really want. We know what we want as regards water-supply and drainage for municipalities and towns, but it seems to me that this section of engineers is not in a position to draft any resolution bearing on the health and general improvements of towns, and unless we know exactly what Health Acts are in existence in India and in the various provinces, we may be up against quite a different proposition to what Mr. Madeley originally started.

MR. MADELEY :—Speaking on the amendment, Mr. Montgomery has expressed very much my view. Originally I thought of proposing a Public Health Act. But I thought we would never get anything done, because it is such a wide subject. Water-works and drainage bye-laws are so badly needed now and it is better to do something to get them

through. If we propose a general Public Health Act we should certainly want to have a joint conference with the sanitary commissioners.

MR. ROBERTSON :—Is it the idea to draw up bye-laws to be enforceable for the whole of India, or is it intended to have model bye-laws which municipalities may modify to serve their needs ?

MR. HUTTON :—Does any one second Major Beadon's amendment ? (No one seconded it.) As the amendment is not seconded, I think we will go back to the resolution. Does any one second Mr. Madeley's resolution ? Major Oldham seconded the resolution which was carried unanimously.

MAJOR OLDHAM proposed the following resolution :—The Engineering Section of the Conference repeats the recommendation made at the Madras Conference that there should be a Joint Secretary for the Engineering Section of the Sanitary Conference.

The resolution was seconded by Mr. Disney and carried unanimously.

MR. SALKIELD :—I should like to ask the opinion of this meeting whether we consider it is possible to bring forward any resolution with regard to the diameter of wheels and the width of tyres. Do you think it is possible to bring that forward with any chance of success ?

MAJOR BEADON :—Well, Sir, I did think of moving a resolution on this point, but it is such a small point that I think the local bodies should be left to look after themselves.

MR. SALKIELD :—It is only a question as to whether the special attention of local bodies should be brought to the matter or not ?

MR. MADELEY :—At the last Sanitary Conference one of the resolutions gave a list of the particular subjects that we recommended to be considered by the Engineering Section of future sanitary conferences. And having done that at one conference we ought perhaps to do something at this Conference. It was only at the last Conference that we decided on a selection of subjects. If we had a list of last year's subjects we could repeat all that required further consideration.

MR. MADELEY suggested that one of the subjects for discussion next year might be the latest types of sewage disposal works suitable for large and small communities in India.

MR. MADELEY :—I would also suggest as a subject for next year's Conference that we should be supplied with statistics of sedimentation and filtration of water for domestic supplies. There is a good deal of information available in many of our large municipalities and it would be a great advantage if they were placed at the disposal of the delegates.

MR. HUTTON read out the subjects that were laid down at the last Sanitary Conference.

MR. MONTGOMERY :—I have two new subjects to add :—

(1) The prevention of dust on roads.
(2) Prevention of waste in water supplies.

MR. MADELEY :—I should like to add to the list of subjects :—

Statistics of sedimentation and filtration of water.

MR. GUBBAY :—You will notice that all the engineering papers submitted to this Conference are for works necessary for large towns—for those with a population of over 5,000 inhabitants. The Government of India have brought to your notice the importance of rural sanitation and you know that grants have been made for the improvement of rural sanitation and it therefore seems to me desirable that some papers on sanitary engineering works for villages and towns of less than 5,000 inhabitants be invited. It is rather a small subject, but it seems to me it is one in which there is a field for discussion.

MR. GUBBAY here proposed his additional subject :—Water-supply for small villages.

THE PRESIDENT :—The following are new subjects which might be adopted by this section in addition to those which were proposed last year.

1. (1) Latest types of sewage disposal works suitable for large and small communities in India.
   (2) Prevention of dust on roads.
   (3) Statistics of sedimentation and filtration of water.
   (4) Prevention of waste in water-supplies.

MR. MONTGOMERY :—I don't know whether it is worth while including this subject, but there seems to be a great variance of opinion as to the best methods of sinking deep bores in India. Some engineers approach it in the most light-hearted fashion. Others know a good deal more about it and I think certainly one gentleman who could give us a paper on how to sink deep bore tubes either for obtaining water for testing the sub-soil or what not. It would be extremely useful.

On this discussion another subject was added to the list :—

(5) Methods of sinking deep bores for water-supplies and other purposes.

MR. BALL HILL :—I should like to suggest one other subject—the flow-off from drainage areas.

After discussion the following subject was added :—

(6) Run-off from large and small catchment areas.

The meeting then adjourned for an exhibition of lantern slides.

SEVENTH AND EIGHTH DAYS, 25TH AND 26TH JANUARY.

Visit of Inspection to Benares and Magh Mela, Allahabad.

A PARTY of 100 delegates of the All-India Sanitary Conference left Lucknow on Saturday night at 11-30 P.M. for a visit to Benares and Allahabad.

At 7 A.M. on Sunday morning the train drew up at the Cantonment station at Benares and the whole party were taken in carriages and motors, kindly lent by the residents of Benares, to Assi ghat.

On the way to Assi ghat a halt was called at Massan ghat where Mr. Bailey, the Municipal Engineer, explained the town improvement and drainage works in progress there.

At Assi ghat, a trickling filter for sullage water which has been in use for some years was examined. This filter will shortly disappear as the sullage at this point will be taken back into the main sewer.

From Assi ghat the whole party embarked in two large boats kindly lent by the Maharaja of Benares and proceeded down the river as far as the Dasasumedh ghat where the party alighted to see the famous Manmandir observatory built in 1693 by Raja Jai Singh of Amber.

The party then re-embarked and were rowed down to Gai ghat passing on the way Manikarnika ghat, the holy burning place of the Hindus, and the other notable ghats. A feature of interest was the new intercepting sewer just constructed to catch the drainage from the houses above so as to prevent the bathing places being polluted.

From Gai ghat the party were driven to Nandeshwar Kothi which had kindly been placed at their disposal by the Maharaja of Benares. The whole of the lower flat of the guest house was reserved for ladies and in the grounds two magnificent *shamianas* had been erected as dining rooms and reception rooms.

After breakfast the gentlemen of the party were again driven down to the city to inspect the more important municipal works which had been carried out, and among other things the new Biseshwarganj markets, the drainage of the *pucca* Mahals and the water-works were examined. The party then returned at 3 P.M., and after tea a short discussion took place on the nature and extent of the filtration experiments which it was proposed to undertake at Benares. Those responsible for the Municipal administration of Benares, the Collector and Chairman, Mr. Streatfeild; the Municipal Engineer, Mr. Bailey; and the Municipal Secretary, Mr. Mukerjee, enlightened the delegates on various points connected with municipal work. After the discussion several delegates started off for Sarnath, some visited the temples and others the brass and embroidery markets. At dusk an expert juggler entertained the party till dinner was served.

The special train left Benares the same evening and arrived at Allahabad at 7 A.M. on Monday morning. The party set off in boats to view the bathing festival and arrangements in connection with the Magh Mela. It is estimated that over 800,000 people had collected to bathe at the Sangam or Junction of the Ganges and Jumna and it was a most interesting and impressive sight.

After viewing the mela the party proceeded to the Fort and inspected the underground temple there and the famous Asoka Pillar dating from 250 B. C.

From the Fort they drove to the Allahabad Club where breakfast was served in the ball-room. The special train for the return journey left Allahabad at 2 P.M., returning to Lucknow after dusk.

The following papers were taken as read in connection with the visit to Benares :—

(1) Benares, I.—Drainage. II.—Minor improvements III.—Water-works. By Mr. C. A. C. STREATFEILD, I.C.S. *

(2) Note on the maintenance of a sewerage system for an Indian city. By Mr. H. BAILEY. †

The following are summaries of the papers.

Benares.

(1) *I.—Drainage.*—The drainage system of Benares is described and mention made of the sewer built in 1829 by Mr. Prinsep, of the extensions under the direction of Mr. Gibbins about the time of the Mutiny, of the modern sewers built in 1889, and the additions recently made by Mr. Bailey, the present Municipal Engineer. A map of Benares with the modern sewage system is attached to the paper.

II.—Minor improvements.—A dhobi ghat, a municipal market, town improvement and town extension schemes are recent examples of municipal sanitary enterprise.

III.—Water-works.—The water-supply for Benares comes from the Ganges at Bhadiani and is pumped up to Bhelapur, where it is filtered and pumped for distribution in the city.

The question of pre-filtration is one that is yet unsettled, and Government is using the water-works at Benares as an experiment to try various systems. The author states the advantages and disadvantages of locating the pre-filters before the settling tanks.

Water wastage is a problem confronting all Indian municipalities. In Benares the present consumption is 20 gallons per head, but experiments demonstrate that this is too low, as 40 gallons per head was the quantity used in the cold weather. This would be much increased in the hot weather. Unless wastage is checked, it grows with the supply and a system of metering is essential. The Deaconian system of metering is now being installed in Benares. The question of what is the legitimate consumption of water for an Indian city has not yet been settled.

(2) *The maintenance of a sewerage system for an Indian city.*

The importance of attention to detail in the maintenance of sewerage systems is emphasised—constant and careful supervision is essential.

The staff employed should be thoroughly organised and systematically allotted, to various duties, *e.g.*, cleaning, flushing, repairing, each gang having a responsible head-man in charge.

A short note on the house connections, gully-pits, and general arrangements in the Benares sewerage works is given.

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* Volume V.

† Volume III.

NINTH DAY, TUESDAY, 27TH JANUARY.

FULL CONFERENCE

THE HON'BLE SIR HARCOURT BUTLER, K.C.S.I., C.I.E., I.C.S., PRESIDING.

RESOLUTIONS.

Proposed.	*Adopted.*
1. That in view of the reported success in mitigating malaria which has attended methods of *colmata* and *bonificazione* in Italy, and the probability that such methods would have similar results in certain parts of India, further investigation of the subject is desirable both in Italy and in suitable localities in India, and that as a preliminary measure a small expert committee consisting of one medical officer and one engineer should, if possible, be deputed to Italy under the auspices of the Indian Research Fund Association.	1. As proposed.
2. That in view of the resentment to which, under present conditions in India, hasty or energetic interference with everyday sanitation in villages is likely to give rise, progress in rural sanitation must be slow: that it is essential to secure the co-operation of the public before any real advance can be made; that in consequence attention should be devoted, for the present, mainly to (*a*) the extended use of tube-wells, where feasible, in school compounds and at places of concourse, such as markets, fairs, thanas, kutcherries, etc.; (*b*) the provision of travelling dispensaries; (*c*) the teaching of elementary hygiene in schools; (*d*) the instruction of midwives; (*e*) the constitution of village sanitary committees; and (*f*) the appointment of health officers for rural areas.	2. "That it is desirable to study rural sanitation, and to push forward such schemes as are practicable, and that special attention should be devoted, for the present, to (*a*) the extended provision of protected water-supply in school compounds and at places of concourse such as markets, fairs, thanas, kutcherries, etc., (*b*) the provision of travelling dispensaries; (*c*) the teaching of elementary hygiene in schools; (*d*) the instruction of midwives; (*e*) the constitution of village sanitary committees; (*f*) the appointment of health officers for rural areas; (*g*) the construction of model villages laid out on sanitary principles in a few selected localities; and (*h*) the extension of village sites in congested districts wherever necessary.
3. That the medical inspection of schools and scholars, special attention to the hygienic condition	3. As proposed.

Proposed.	*Adopted.*
of schools, the provision of playgrounds, etc., are eminently desirable from the point of view of public health.	
4. That the results which have been obtained in Delhi, demonstrate the importance of efficient scavenging and the proper disposal of night-soil and refuse, especially stable litter and organic matter, in the neighbourhood of the house, with a view to the mitigation of the fly nuisance and the consequent relief from much of the discomfort, and many of the dangers, to which the public are exposed.	4. That the attention of all municipalities and local authorities be drawn to the danger to health due to the presence of flies, and that every attempt should be made towards introducing more stringent regulations and methods for the prompt collection, removal and disposal of refuse, especially stable litter and other organic matter, in the neighbourhood of dwelling houses.
5. That with regard to the very high rate of infantile mortality in all parts of India, but especially in the larger towns, it is desirable to emphasise the necessity of educating the mothers and *dhais*, and as a means of dealing with this problem, to draw attention to the encouraging results which have attended the employment of nurse district visitors in Bombay and Madras.	5. As proposed.
6. That an accurate knowledge of the distribution and causation of sickness and death is of supreme importance as the foundation on which all schemes of sanitary improvement should be based, and that, therefore, the collection, compilation and tabulation of vital statistics should be considered one of the chief duties of every health officer, whether of a district or a municipality.	6. That an accurate knowledge of the distribution and causation of sickness and death is of supreme importance as the foundation on which all schemes of sanitary improvement should be based, and that, therefore, the collection, compilation and tabulation of vital statistics should be considered one of the chief duties of every health officer whether of a district or of a municipality.
That, under present conditions in India most people die without having been attended in their last illness by competent medical men, and that in consequence the impracticability of compulsory notification must be accepted for the time, but that voluntary notification should be encouraged wherever possible.	
7. That the present prevalence of tuberculosis in India is such as to demand serious attention and special measures for dealing with it: that one or more officers should be placed on special duty to study in detail the distribution of the disease, to investigate the causes	7. That the present prevalence of tuberculosis in India is such as to demand serious attention and special measures for dealing with it; that officers should be placed on special duty to study in detail the different problems affecting tuberculosis in India, to investigate

Proposed.	*Adopted.*
underlying it and to organise methods of diffusing information on the subject: also that great circumspection should be exercised before instituting, at considerable cost, further Tuberculosis Sanatoria; in this country such institutions have an educational rather than a therapeutical value.	the causes underlying it, and to organise efforts towards the diffusion of information on the subject, and measures for the prevention of infection; also that circumspection should be exercised before instituting, at considerable cost, further Tuberculosis Sanatoria. What are now really required are inexpensive buildings modelled after the homes of the people, so as to have greater educational value.
8. That special attention be directed to the serious danger arising from the present indiscriminate use of tuberculin by medical practitioners not possessing the requisite special experience.	8. That serious danger arises from the indiscriminate use of tuberculin by medical practitioners not possessing the requisite special experience.
9. That with reference to proposed legislation for the regulation of food and drugs in India, it is necessary that chemical standards of purity for milk and milk products should be established: that European standards are not applicable, and that, therefore, further investigation to obtain suitable standards, and also information as regards the methods of detecting the various adulterants, is desirable.	9. As proposed.
10. That in order to prevent the adulteration of milk which is now practically universal in India, improvements in the production and distribution of milk are urgently necessary, but that in view of the present high price of this commodity and the fact that any further increase would seriously affect poor consumers, it is essential that organisation should precede restriction, and that there should be mutual help and co-operation between sanitarians, the milk dealers and the Agricultural Department.	10. As proposed.
11. That all municipalities which have not already done so, should introduce satisfactory building and drainage bye-laws and make adequate arrangements for enforcing them, and that if any municipality fail to take action, higher authority should be empowered to compel them to do so.	11. As proposed, with the addition of the word "water" after "building"
12. That it be suggested to local Governments that (1) the preparation and execution of town-planning and housing schemes; and (2) the	12. As proposed.

Proposed.	*Adopted.*
acquisition of land in process of development in the neighbourhood of growing towns, are legitimate objects of municipal expenditure.	
13. That compensation for the acquisition of buildings which are unfit for human habitation should be limited to the value, with no addition on account of compulsory acquisition.	13. That compensation for the acquisition of residential buildings which are declared by competent authority to be unfit for human habitation, and the sites on which they stand, should be limited to the value awarded with no addition on account of compulsory acquisition.
14. That the progress of sanitation is greatly impeded on all sides by the want of sanitary engineers.	14. That the progress of sanitation is greatly impeded on all sides by the want of sanitary engineers, and that the establishment of sanitary engineers should be placed on an adequate basis to meet the demands for the design and execution of sanitary works.
15. That the results obtained have already established the value of carefully carried out malaria surveys which have in several instances brought to light important and unexpected facts regarding the causation of malaria in particular localities.	15. That the papers read at the Conference have again established the value of carefully carried out malaria surveys which have, in almost every case, brought to light important and unexpected facts regarding the causation of malaria in particular localities.
16. That although under certain circumstances rice cultivation may be extremely dangerous, there appears evidence that many rice growing districts are extraordinarily free from malaria, and as the reasons for this are still imperfectly known, it is most important that this subject, which was emphasised by the Conference at Madras, should receive continued close attention.	16. As proposed, with the addition of the word "extensive" before "rice growing districts, etc."
17. That in view of our knowledge of malaria prevention it is of first importance that efficient screening be provided for all bungalows of persons who are working in hyperendemic or dangerously malarious areas.	17. As proposed.
18. That it would be helpful if all-Indian workers, following the example of the British Museum Authorities, would, for purposes of classification, include all anophelines under the genus *Anopheles*.	18. As proposed, except that for "all Indian workers" was substituted "workers on malaria in India," and for "classification" the word "nomenclature."
19. That the additional evidence before the Conference emphasises the facts (1) that villages infected late in one plague season probably play an important part in carrying over infection to the follow-	19. That the importance of active anti-plague measures during the off-season should be emphasised. That the method suggested in Captain Kunhardt's paper for selecting the villages to be operated

Proposed.	*Adopted.*
ing plague season; (2) that it is possible to identify those villages and deal with them in such a way as to prevent or postpone a recurrence of the disease; and (3) that results of great value would be obtained by an experiment on a large scale with well organised schemes of rat destruction carried out during the quiescent period and before the onset of the following epidemic.	on, is of considerable value, but should be supplemented by careful personal inquiries amongst village communities. That systematic rat destruction is the best plan of campaign. That further investigations into the manner in which plague is carried over from one epidemic season to another in different infected areas, should be strongly recommended.
20. That further investigation is necessary on the subject of the etiology of beri-beri.	20. Withdrawn.
21. That attention be invited to the discussion on the method of raising revenue to defray water charges, and more particularly to the opinion expressed therein that model bye-laws for the assessment of water-rates might with advantage be drawn up, where not already in existence.	21. Withdrawn.
22. That the following list should be added to the subjects selected at the Madras Conference for treatment: (1) latest types of sewage disposal works suitable for small and large communities in India; (2) prevention of dust on roads; (3) statistics of sedimentation and filtration of water; (4) prevention of waste in water-supply; (5) method of sinking deep bores (for water-supplies or other purposes); (6) run-off from large and small catchment areas.	22. As proposed.
23. The engineering section of the Conference repeats the recommendation made at the Madras Conference, that there should be a Joint-Secretary for the Engineering Section of the Sanitary Conference.	23. "That there should be a Joint-Secretary for the Engineering Section of the Sanitary Conference."

The discussion on the resolutions was as follows:—

Resolution No. 1—

THE HON'BLE MR. C. H. HUTTON suggested that before any more officers were deputed to Italy a Select Committee composed of a medical officer and an engineer should be formed to examine and report how far the Italian system of reclamation by silt is applicable to those parts of India where the conditions are more favourable than they are in these provinces, and whether such work can be undertaken at a reasonable cost. If their report was favourable an experiment might be made and conditions watched. He thought Bengal a suitable field for such enquiry because the trouble there was not too little silt but too much silt. In Italy, as Dr. Bentley had already pointed out, silting operations are conducted during the non-malarious season, and suspended during the summer months when malaria is prevalent, as there are then no silt-bearing floods. During these months the greatest care is taken to drain the basins of water and to keep their margins clear of jungle. In this country silting operations must be conducted during the malaria

season and the effect of such operations on the neighbouring population at that season must be studied. It seemed to him that it would be likely to lead temporarily, at any rate, to an increase of malaria.

THE PRESIDENT pointed out that the resolution contemplated that as a preliminary measure there should be investigation in suitable localities in India as well as in Italy.

DR. BENTLEY pointed out that his experience in Bengal was that where there was excessive water and a plentiful supply of silt there was little or no malaria, and it was where the land had been deprived of its natural silt that malaria was prevalent. He had already suggested that they should restore the natural conditions of the delta. Of course, an investigation was necessary to start with.

The resolution in its original form was put to the vote and carried with one dissentient.

Resolution No. 2.—MAJOR BUCK objected to the first part of this resolution as it stood. He would ask the framer of the resolution where and when he had found resentment at attempts to improve village sanitation. Personally he had always found villagers quite willing to have paved streets, repairs of wells and parapets, embankments, construction of culverts and petty drainage schemes. The difficulty was merely one of finance. He therefore proposed that the resolution should be altered to read as follows :—

> "That it is desirable for sanitary officers to study rural sanitation and to push forward such schemes as fall in with the views of the people."

DR. TURNER thought that if they had to wait for the views of the people they would have to wait a very long time. They had heard a good deal of late of voluntary effort: there is no such thing as voluntary effort in sanitary matters amongst the people of India.

THE PRESIDENT suggested that the words "as are practicable" should be substituted for the words "as fall in with the views of the people."

MR. RAO proposed the addition of three clauses :—

(*g*) Construction of model villages laid out on sanitary principles in a few selected localities.

He considered this essential both as an object-lesson to villagers and for the purpose of watching any sanitary improvement that might be effected by the construction of such model villages. At the last Conference they had adopted a resolution about the construction of model towns: it would be in furtherance of rural sanitation if a resolution for the construction of model villages laid out on sanitary principles were also adopted.

(*h*) The extension of village sites in congested districts wherever necessary.

This also was an object which would not evoke much opposition owing to the fact that in several districts the village sites were much congested. If funds were available this was certainly an object on which money might be spent.

(*j*) The provision of better drainage in irrigated tracts wherever necessary.

With reference to clause (*a*) he suggested the addition of the words "and the separate provision of water supply to men and cattle where the main source of supply is tanks."

COLONEL BROWNING SMITH was in doubt whether the resolution should start by drawing the attention of sanitary officers to rural sanitation. Sanitary officers did study rural sanitation and it was not their attention alone which should be drawn to this matter. The term sanitary officers rather applied to medical experts; district boards, etc., were really in charge of rural sanitation.

MAJOR OLDHAM suggested the substitution of "protected wells" for "tube wells."

DR. NEWELL thought it undesirable to say tube wells as these were at present at a very experimental stage.

THE PRESIDENT suggested that they should substitute the words "protected water supply," for tube wells.

MR. RAO'S amendments were then put to the vote with the following results :—

(*g*) was carried by 43 votes for and 25 against.
(*h*) was carried by 33 votes for and 25 against.
(*j*) was put to the vote and lost.

The resolution was accepted in the form shown *ante*.

Resolution No. 3.—Was adopted as proposed.

Resolution No. 4.—DR. TURNER thought that more emphasis should be laid on the danger of the fly.

RAI BAHADUR GANGA PRASAD VARMA thought that attention should be drawn to the necessity for having closed drains. The greater prevalence of flies in Northern India as compared with Calcutta, Karachi, etc., was due in a large measure to open drains.

DR. NEWELL thought that in view of the fact that it was general knowledge that efficient scavenging was necessary, any further reference to the subject by the Conference was not required.

DR. TURNER thought it was very important to have a resolution on the subject.

The question whether there should be a resolution at all in view of last year's resolution regarding flies was then put to the vote, 57 voting in favour of having a resolution and 24 against. The resolution No. 4, shown *ante* was then adopted.

Resolution No. 5 as proposed, was carried with one dissentient.

Resolution No. 6.—The first part of this resolution was adopted as proposed was carried.

DR. TURNER thought that the necessity for some scheme for improving the certification of death and insisting on compulsory notification of infectious diseases should be impressed on the attention of medical men and Local Governments.

DR. BENTLEY did not think the second part of this resolution necessary. He thought it would weaken the first part of the resolution.

This question was put to the vote and it was agreed that the second part of the resolution be omitted.

Resolution No. 7.—THE HON'BLE RAI SRI RAM BAHADUR enquired whether "one or more officers" in the resolution meant one or more officers for each province or for the whole of India.

THE PRESIDENT said the question would be ultimately decided by the Research Fund Association and suggested the omission of the words "one or more." This was agreed to.

DR. LANKESTER thought that something more definite was required than the words "to organise methods of diffusing information" and suggested "to organise efforts towards the diffusion of information and measures for the prevention of infection." This was agreed to.

DR. DE MELLO suggested that instead of the words "distribution of the disease," the words "different problems affecting tuberculosis in India" should be substituted. This was agreed to.

The HON'BLE RAI SRI RAM BAHADUR proposed that the last sentence "in this country such institutions have a great educational value" should be omitted. This was put to the vote and lost, 13 voting for it and 34 against.

At the suggestion of Sir Malcolm Morris this last sentence was altered and the resolution No. 7, as shown *ante*, was finally adopted.

Resolution No. 8.—MAJOR PERRY asked whether it was the attention of Local Governments or of health officers that should be directed in this case.

These words were accordingly omitted and the resolution was finally adopted as shown *ante*.

Resolution No. 9.—MR. COWASJEE proposed that after the word "necessary," the words "that powers be conferred on municipalities in respect of control of cow-sheds which are outside municipal limits and from which milk is supplied to towns" should be added. This was put to the vote and lost, 12 being in favour and a large number against it. The resolution in its original form was carried.

Resolution No. 10.—Was carried as proposed.

Resolution No. 11.—MR. WILLIAMS :—I should like to draw attention to the necessity for a municipality before introducing satisfactory drainage bye-laws to introduce satisfactory drains. I remember a case in Bengal in which a municipality flatly refused to spend a half-penny on drains and shortly afterwards came up with most elaborate bye-laws.

MR. MADELEY :—As one who has had to draw up bye-laws in a large city and knowing some of the difficulties of drawing up satisfactory bye-laws, I do not think the smaller municipalities could afford to have officers who would really be competent to draw up the bye-laws, especially as in drawing up bye-laws you generally find the Municipal Acts are very different. In my case in Madras I have found that the Act requires amendment and I have endeavoured to draw up new clauses for the Act as well as model bye-laws. In England it has been found necessary to adopt standard bye-laws. The Engineering Section put up a resolution about this. I should like to ask if there is any possibility of this resolution being passed either in this form or in a modified form.

PRESIDENT :—Would the Conference accept it if we left out of this resolution the words "drainage bye-laws ?"

MR. MADELEY :—The intention was, Sir. that these model clauses might be adopted in the Municipal Acts with such modifications as might be required by local conditions. Similarly with the model bye-laws which would be adopted either in whole or in part as necessary for a particular case.

PRESIDENT :—This is a very large direction for a Conference like this to give. In the first place it raises the issue whether the Government of India or the Local Governments should draw up and pass their Water Works and Drainage Clauses Act. I could not accept a resolution here that the Government of India should pass an Act for the whole of India.

MR. MADELEY :—Could you put it "that this Conference considers it highly desirable that....."

PRESIDENT :—What is to be gained by having one Act for the whole of India ?

MR. MADELEY :—The municipalities find that they have not the power they thought they had. The Madras Government has been in the courts over one drainage case and I know Colombo has found they had not the power to enforce house connection. At home they have a Water Works Clauses Act which is incorporated in the Acts which are promoted in Parliament.

PRESIDENT :—I don't think there is the slightest chance of this being accepted by the Local Governments. What is essential for you is as far as possible to have uniform water supply and drainage bye-laws. (Mr. Madeley :—Yes, Sir, we want the powers to make them.) You had better leave out the clause about the Drainage and Clauses Act,—most provinces have one—and say that model sets of water supply and drainage bye-laws should be drawn up. Won't that meet you ?

DR. TURNER :—I move that No. 11 be passed as it is. It seems to cover everything. The higher authority in the natural course would see to things.

MAJOR BEADON :--May I move an amendment. I was present at the Engineering Section when this matter came up and I had the same doubt that has been expressed just now. My brain was not nimble enough to grasp the point at that moment, so I have drafted a resolution.

"That this Conference considers that the attention of Local Governments should be invited to the advisability of framing model bye-laws for the consideration of the municipal authorities, especially bye-laws dealing with buildings, water supplies and drainage." I think that covers the whole point.

PRESIDENT :—I put the amendment first.

MAJOR JUSTICE :—Will you excuse me, Sir, I think most Local Governments have already done so.

DR. HIRST :—We might say "introduce or adopt satisfactory drainage bye-laws."

PRESIDENT :—I think we may put Major Beadon's amendment. Why should it not run "that attention should be invited to the advisability of framing model bye-laws."

A DELEGATE :—If any municipality fails to take action, a higher authority should be entitled to compel them to do so.

MAJOR BEADON :—I think we have that power.

MAJOR JUSTICE :—They have not got the power under the Acts. The sections of the Acts should be amended if the bye-laws are to be of any service whatever.

RAI BAHADUR WAZIR SINGH :—Under the Punjab Municipal Act the Local Government have the power.

DR. TURNER :—I move that No. 11 be passed as it stands. The Resolution was then put to the meeting in the form shown *ante* and carried.

Resolution No. 12.—Carried as proposed.

Resolution No. 13.—The Hon'ble Mr. GANGA PRASAD VARMA :- Instead of the words "which are unfit," I would suggest "which have been declared unfit by the municipal board."

PRESIDENT :—Would you accept "by competent authority?"

MR. VARMA :—Yes.

RAI BAHADUR WAZIR SINGH :—I would suggest, Sir, the word "compensation" instead of "value" and "land" instead of "building." The object of this Conference is that in cases where houses are declared to be unfit for human habitation and where it is necessary to acquire them, the committee may not be compelled to pay 15 per cent. In that case we can say instead of "building," "land," and instead of "value" we can say "compensation."

PRESIDENT :—You mean that "buildings" are included in "land."

MR. ORR :—"Land" is defined in the Acquisition of Land Act. Surely you cannot say "land which is unfit for human habitation." As the resolution is drafted it is, I think, wrong. It reads "compensation for the acquisition of buildings which are unfit for human habitation, and so on." A godown is unfit for human habitation, but it is not the object of this Conference to deprive the owner of a godown of compensation. It would suit if we insert "residential" before the word "buildings."

MAJOR BEADON :—It seems to me that the proposal is to alter the provisions of the Land Acquisition Act.

PRESIDENT :—The object of the Resolution, I understand, is that many improvements are rendered impossible owing to the necessity of giving this large sum as an additional compensation which, in the case of Calcutta and Bombay, is not given under special enactment. It is possible there is a difference of opinion about this and I will first put the general principle to the vote.

Will those who are in favour of wiping out this 15 per cent. compensation for compulsory acquisition in the case of residential buildings declared by competent authority to be unfit for human habitation,

and think it of sufficient importance to make a recommendation to Government, hold up their hands.

The show of hands was in favour of the principle.

PRESIDENT :—I think the sense of the Conference is that the principle is such as it is stated in the resolution. We now come to the wording of it. I will first put Mr. Orr's wording to the vote : " that compensation for the acquisition of residential buildings, etc."

MR. WEST :—I should like to add after " habitation " and " the sites on which they stand."

DR. TURNER :—I think it would be better to leave the Resolution as it stands. If we try to define the word " residential," we shall get into trouble. Places which are not actually residential buildings are frequently used for residences.

PRESIDENT :—Mr. Orr's point is this, that you may have a godown which is never intended to be fit for human habitation, and on that ground you will deprive the owner of the 15 per cent. compensation which under the common law he would be entitled to. I will now put the Resolution in this form : " That compensation for the acquisition of residential buildings which are declared by competent authority to be unfit for human habitation, and the sites on which they stand, should be limited to the value awarded with no addition on account of compulsory acquisition."

The Resolution was carried.

Resolution 14.—THE HON'BLE MR. RAMACHANDRA RAO :—I propose to add the following, " and that the establishments of sanitary engineers should be placed on a satisfactory basis to meet the demands." It seems to me that the Resolution, as it is worded, does not lead to any definite recommendation. Of course it is a fact that the number of sanitary engineers is very inadequate in the provinces, and I think it is the object of this Conference to suggest to the Local Governments that the establishments of sanitary engineers should be placed on an adequate basis to meet the demands for the design and execution of sanitary works.

PRESIDENT :—I will accept that (repeated the Resolution with the amendment suggested).

THE HON'BLE MR. RAMACHANDRA RAO :—I would also suggest the addition of the words " and that the Conference recommends that the services of sanitary engineers be organised on the lines on which health officers have been organised." I may say that the Government of India have provided large municipalities with health officers, and I would suggest that the service of sanitary engineers be organised on the same lines.

PRESIDENT :—I am not prepared to accept that. It is not for this Conference to say whether Local Governments should pay or that the Government of India should pay. That I cannot allow, as it refers to the relations between the Local Governments and the Imperial Government.

The Resolution was then put to the Conference in the form shown *ante*, and carried.

Resolution 15.—MAJOR CHRISTOPHERS said :—I would suggest that in place of the words " the results obtained have already," should be inserted : " That the papers read at the Conference have again established, etc.", and lower down " in several instances " should read " in almost every case."

PRESIDENT :—We accept that.

The Resolution as amended by Major Christophers was then put to the meeting and carried.

Resolution No. 16.—COLONEL DONOVAN :—In the sentence " that many rice-growing districts, etc.", I would suggest the addition of the word " extensive " before the word " rice."

The Resolution as amended was carried.

Resolution No. 17.—Carried as proposed.

Resolution No. 18.—COLONEL DONOVAN suggested that "Indian workers on malaria" should be substituted for "all Indian workers;" this was eventually changed to "Workers on malaria in India."

MAJOR CHRISTOPHERS suggested the substitution of "nomenclature" for "classification," which was accepted.

Resolution No. 19.—The resolution as shown *ante* was substituted for that proposed and was carried.

Resolution No. 20.—MAJOR GREIG:—I would like to point out that no special papers dealing with beri-beri have been laid before this Conference. In one paper only dealing with another subject was the question dealt with as a side issue. This Conference has not had the advantage therefore of a full presentation of the present position of the beri-beri problem. The Conference in these circumstances should make it clear in the resolution that it is prepared, in the meantime, to recommend that research should be continued on the same lines as those which workers all over the world have shown by careful scientific investigation, to yield the most hopeful results in the prevention of this disease. The resolution as it stands may convey the impression that the Conference doubts the value of this work. I think this would be unfortunate, seeing that the Conference has not fully discussed the question. I am not opposing further research in this question; I am strongly in favour of it.

I have slightly modified the resolution. May I read it?

"That further investigations on the subject of the etiology of beriberi be carried out. Having regard to the results of recent research on this question in different parts of the world, special attention be devoted to the systematic study of diet in relation to the causation of this disease in India."

PRESIDENT:—The question is whether it may not be left out altogether.

The Conference decided to omit the resolution.

Resolution No. 21.—DR. TURNER:—I think, Sir, the resolution is more or less covered by the insertion of the word "water" in Resolution No. 11, which was passed.

THE PRESIDENT suggested the omission of this Resolution and this was agreed to.

Resolution No. 22.—DR. NEWELL suggested the addition of a 7th subject, namely, "Methods of refuse disposal." This was not agreed to.

MR. BALL HILL suggested the following for the 6th subject on the list.—"Rate and ratio of run-off to rainfall from large and small catchment areas for purposes of (*a*) water-supply, and (*b*) sewerage." "Dhobis' ghats" was also suggested as an additional subject. This was rejected by the Conference, the President adding that no addition should be made to the list which was drawn up by the Engineering Section for their own use, unless the engineers themselves wished to add to it.

Resolution No. 23.—THE PRESIDENT suggested that this resolution should be re-worded: "That there should be a Joint Secretary for the Engineering Section of the Sanitary Conference."

He added that on this occasion they had intended that Mr. West should be asked kindly to be the Joint Secretary, but there was some misunderstanding. He would say that it was the intention to give effect to that recommendation, and he hoped that next time they would not have to pass a resolution. He could however see the importance of getting it down on record again, because it might be overlooked otherwise.

MR. MONTGOMERY here expressed a hope that the Joint Secretary would not be the Sanitary Engineer of the province in which the Conference was held.

MR. MADELEY explained in connection with the previous resolution that the engineers did not wish to restrict themselves to these

special subjects, but that they had selected them as the most suitable for discussion in addition to those which had been listed last year.

The Resolution was put as amended and carried.

MAJOR BEADON :—" In your opening speech, Sir, you said that there are many municipal matters of absorbing interest which had nothing whatever to do with the Sanitary Conference. I should like to point out that out of the 88 delegates who have been sent to this meeting from the provinces, as apart from those delegates appointed by the Government of India, no less than 40 are connected with the actual administration of municipalities, as apart from being medical men and as apart from being engineering experts, and it seems to me that it is a pity to waste the opportunity of having so many gentlemen who are interested in municipal matters present and not allow matters of general municipal interest to be brought before this meeting. In these circumstances I think it would be very advisable if the work of this Conference could be extended so as to include these matters, and I suggest that in addition to the purely medical section and the purely engineering section, that a third section be formed called a municipal section, and I would suggest that this section also have its own secretary just as the engineers got their own secretary a few moments ago. I hope I shall not be considered presumptuous if I say that your Department has not only charge of sanitation but also of all municipal matters, as all our municipal reports come up before you. I would propose the following resolution :—

' That in view of the importance which now attaches to the practical administration of Indian cities, this Conference is of opinion that at future conferences a sub-section should be formed for the discussion of such municipal matters as may be brought before it ; and further that a separate secretary be appointed for this section.'

I have been discussing this matter with a great many gentlemen who have come from various parts of India and there seems to be a general consensus of opinion that we should have such a section and I hope, Sir, that you will be able to help us in the matter."

PRESIDENT :—" I don't quite understand what class of subjects you would discuss. Anything bearing on sanitation has I think been pretty thoroughly discussed at this Conference. My only reason for the observation at the beginning of this meeting was that I did not wish in any way to restrict discussion. But I did think it advisable to restrict resolutions to the sanitary side, because if we once get drawn into having a discussion on general municipal administration, I think we shall travel very far from the natural limits of a conference of this kind. Before putting this resolution to the vote, I should like Major Beadon to tell us what class of subjects would be discussed by this municipal section."

MAJOR BEADON :—" Everything connected with municipal administration, Sir, finance, etc. I should like to discuss the management of our taxes, how our taxes, for instance, are raised."

PRESIDENT :—"In other words, you want the Sanitary Conference to propose a separate Municipal Conference. You will understand that I could not allow a Sanitary Conference to pass a resolution suggesting that you should have a conference about municipal administration generally."

CONCLUSION.

PRESIDENT :—We will now adjourn until 12-30 and then re-assemble in the Lecture Hall to meet His Honour the Lieutenant-Governor.

The Conference re-assembed on the arrival of His Honour Sir James Meston, Lieutenant-Governor of the United Provinces.

THE PRESIDENT :

"Your Honour and Gentlemen.—I am desired by His Excellency the Viceroy to convey the following message to this Conference: ' Please

convey to the Members of the Sanitary Conference sitting at Lucknow my very cordial appreciation of their valuable labours under your presidency, and my firm conviction that the interesting discussions that have taken place on so many subjects of material and even vital importance to this country, by such a distinguished body of members, will inevitably conduce to the more rapid development of sanitary science and methods throughout India. Please convey to them my personal thanks.'

On behalf of you all I shall convey to Lord Hardinge our respectful and sincere thanks for the interest which he has taken in our proceedings and for his gracious and stimulating words.

Your Honour: we are really grateful to you for coming here to-day. We deem it no mean compliment that in the midst of your arduous and beneficent labours you should find time to give us this high encouragement, and we are glad to have this opportunity of thanking you for the most generous hospitality which Lady Meston and yourself have shown to us here. Our stay in Lucknow has been made very pleasant to us by many kind friends, and I desire, through Your Honour, to convey our heartiest thanks to them all. A feature of this Conference has been the successful tours of inspection to Hardwar, Benares and Allahabad, organised so completely by Major Harriss and Mr. West who, throughout this Conference, have never spared themselves when our enlightenment or convenience has been concerned. I desire to thank them as well as the gentlemen who kindly acted as guides at these three places.

We have now held three large annual Conferences covering the wide subjects of research and hygiene. Each year, as the lines of progress have become more distinct the Conference has become increasingly successful. I think the very success of this Conference should cause us to reflect. It has always been my intention to reconsider the question of these All-India Conferences after the third had been held. Our resolution on Educational Policy was issued after the holding of three Conferences, and I hope that as a result of our third Sanitary Conference, we shall very soon issue a general statement of general sanitary policy. Once this has been accomplished, it is open to question whether we should not meet at longer intervals. I propose to address Local Governments on the subject. At present I am disposed to think that while we should hold annual Conferences in research, it will be sufficient to hold biennial or even triennial Conferences in hygiene.

In conclusion may I thank Your Honour once more for your kindness to us, and you, gentlemen, for the zeal and helpfulness which you have displayed. We have had a heavy programme. We could not have got through it without the strenuous and able assistance of Captain Needham, our Secretary, and Captain Norman White. I think that few of you realise how great a strain this Conference has been on them. It has been successful, and I think that I may fairly claim that we leave this beautiful and kind city with an appreciable addition to our knowledge and with increased hopefulness for the future."

HIS HONOUR THE LIEUTENANT-GOVERNOR:

"Sir Harcourt Butler, Gentlemen.—It requires considerable temerity on the part of the mere layman to address so large and distinguished an audience of experts; but I have acceded with particular pleasure to the most kind invitation of your President to attend here to-day, and to tempt fate by saying a few words as an amateur on subjects which with many of you have been your life study. I do so, as I have said, with particular pleasure, not only because your President is an old and valued friend of mine, but because the few remarks with which I shall trouble you represent thoughts which have been very forcibly borne in upon me since your Conference began its sittings in Lucknow. In the first place then, gentlemen, although late in the day, yet you will realize that I had no earlier opportunity of welcoming you, as I do most heartily welcome you, to the Capital of Oudh, one of the cities of

which we denizens of the United Provinces consider ourselves to be justly proud. I regard it as an unusually auspicious omen that you are met here under the presidency of Sir Harcourt Butler, who did so much in his earlier days for the modern beautification of Lucknow, and in the building of a noble institution which owes its existence in so large a measure to his enthusiasm and foresight. I assure you, Sir Harcourt and gentlemen, that it has been a very real pleasure to my wife and myself, and to all of us in Lucknow, to do what little we have done to enhance the pleasure of your short stay among us. In the second place, I should like to tell you how much we appreciate the presence of your Conference here in its effect on the activity of our provincial intelligence. Thirdly, I make bold to put before you for your sympathy, co-operation and counsel, some of the problems which affect a Local Government in your particular lines of work. These last two points I hope you will permit me to develop in a very few words and without any attempt at technical or professional language.

Gentlemen of the Conference, those of us who are interested in any phase of the great sanitary problems of this province have derived stimulus and encouragement from your visit. The knowledge that so many minds are busy on these problems comes to some of us as a pleasant surprise. It dispels the feeling of isolation which often obsesses men who have to work at technical questions away from the active centres of thought and research. Your Conference creates an atmosphere which breeds enthusiasm. People hear you and see you at close range. They read your proceedings in the local press and talk about them ; while they discuss you and your work, gleams come of new solutions for old problems ; and much that formerly seemed impracticable and hardly worth considering sails into the horizon of the possible and the expedient. From these ten days of your sojourn here I anticipate not only criticism which will be helpful to us, but the stirring of new speculation and practical interest in our local sanitary affairs. You will help us by subtle psychological influences which find no place in your agenda paper.

This leads me to touch on some of the concrete difficulties which face a Local Government from day to day, and on which a Local Government looks to you, the experts, for help and guidance. Take plague, the most imminent of all our present troubles. From the purely administrative point of view we have come to confine ourselves almost entirely to a few very simple methods of handling it. We send travelling dispensaries into the most afflicted districts : and here I pause to acknowledge the zeal and enthusiasm with which our Inspector-General, Col. Manifold, has developed his happy idea of bringing medical relief to the doors of the villagers through these peripatetic dispensaries. Apart from that, all that we can do, in a general way, is to encourage inoculation and evacuation. Personally I feel that, in the absence of a widespread and popular system of prophylaxis, we can do nothing better than help the people in small ways to overcome the discomforts and loss which they suffer in moving out of infected homes. It is clear, however, that we cannot leave the matter permanently at this stage. We wait for you and your colleagues in research elsewhere to discover an effective preventive of this horrible scourge ; and we shall be ready to place the whole of our administrative machinery at your disposal for the purpose when the time comes.

For some of our other great problems you have already given us remedies which it is for us to enforce. The housing question and the treatment of congested areas where disease festers in our large towns, the supply of pure milk, the campaign against malaria, these and many other questions of vital importance have been keenly discussed by you in the last few days. We know your views and accept them, and we admit that it is for us to carry them into practice. But here also we want your help. We have in all such forward movements a dead weight against us of ignorant aversion to change, of ancient usage, of

social susceptibilities. To undermine and move this mountain is the task of the Government; but we ask you to share it. You can give powerful aid in creating an enlightened public feeling on such questions. From your laboratories you can issue warnings and demonstrations which will stir the apathetic and convince the scoffer. Popular lectures, lantern slides, readable leaflets, appeals to the boys at our schools and colleges—all these would help us immensely in battling with prejudice and, believe me, they would not in the end be a waste of your time.

And now, gentlemen, while I ask for your help, I would also ask for your forbearance with those of us who have to carry on the executive government of this country. I can well imagine how cordial would be your acceptance of that famous phrase of Mr. Disraeli's when, as it has been said, by altering one letter in a quotation from the Vulgate, he exclaimed 'Sanitas sanitatum, omnia sanitas.' Holding that faith, you must often fret against the hesitancy of a Government which used to regard sanitation as the Cinderella of its departments. I say we used to do it, because I do not think that this reproach is any longer true. We frequently grumble when you press us along the line of sanitary reform; we sometimes speak about your ideas as fads; we often say that we have no time to help you, and we always say that we have no money. Since, however, Sir Harcourt Butler took over his portfolio, the dry bones, both of administration and finance, have begun to move. Great advances have been made, and the way is being paved for still more remarkable progress. Even so I fear you will often find the movement of the executive government far slower than you would wish; but again I would ask you to bear with us if our response to your enthusiasms is sometimes disappointing. I was very much struck by a passage in a wonderful book which most of you have probably read. The author is describing a typical village in Upper India, situated in the middle of a vast plain of sun-baked clay. From the nature of their homes he passes to the patient fatalistic temperament of the people and says:—'The stages between being gathered out of the clay and being gathered into it are so little distinguishable that birth and death and toil and sleep and resignation are part of the same slow-moving dream in which different states merge indifferently.' This passage seems to me to give a vivid description of the great masses among whom we have to preach the gospel of what is by far the most important side of all your work, I mean the importance of rural sanitation. In face of this temperament as the heritage of centuries, and in face of the complex social sentiments which compose the life of the people, the administrator is bound to pause before he embarks on schemes which, admirable though they may be in themselves, may happen to arouse a bewildered hostility in the minds of the people. Sanitary measures have an economic and a political aspect; and if these aspects are sometimes, especially in our present period of transition, more prominently in the thoughts of the administrator than the purely hygienic side of the question, I am certain that you will not withhold your sympathy from him.

Still, we are all engaged in the same work, the advancement of India in its varied interests; and I am confident that, in the years to come, administrator and scientist, civil servant and sanitarian, will move together, in mutual understanding and forbearance, towards the distant goal.

Gentlemen, once more I thank you for letting me come here to-day and for all the good work which you are doing."

THE PRESIDENT:—"On behalf of you all, before we go to be photographed, I should like to thank His Honour for his most kind and encouraging address. We all recognise the difficulties in carrying out practical schemes, but we all feel confident that in the United Porvinces those difficulties will be, as far as possible, overcome by Sir James Meston and the able officers who are working under him. Once more, I should like to express our deep obligation."

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